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ABSTRACT

Described are awards made in fiscal year 1978-79 and earlier in the Division of Science Education Development and Research of the National Science Foundation. For each project occurring in 1979, a summary description is provided, as well as the home and address of the principal investigator, amount of funding, and duration of the project. Projects are listed alphabetically by State and Institution beginning with Alaska and ending with Wisconsin. Each project occurring in 1978 and earlier years is accompanied by the title of the project and name and address of the principal investigator. An address is provided for acquiring a summary statement, funding, and duration information. An index to location of projects is provided according to investigators. (Author/SA)

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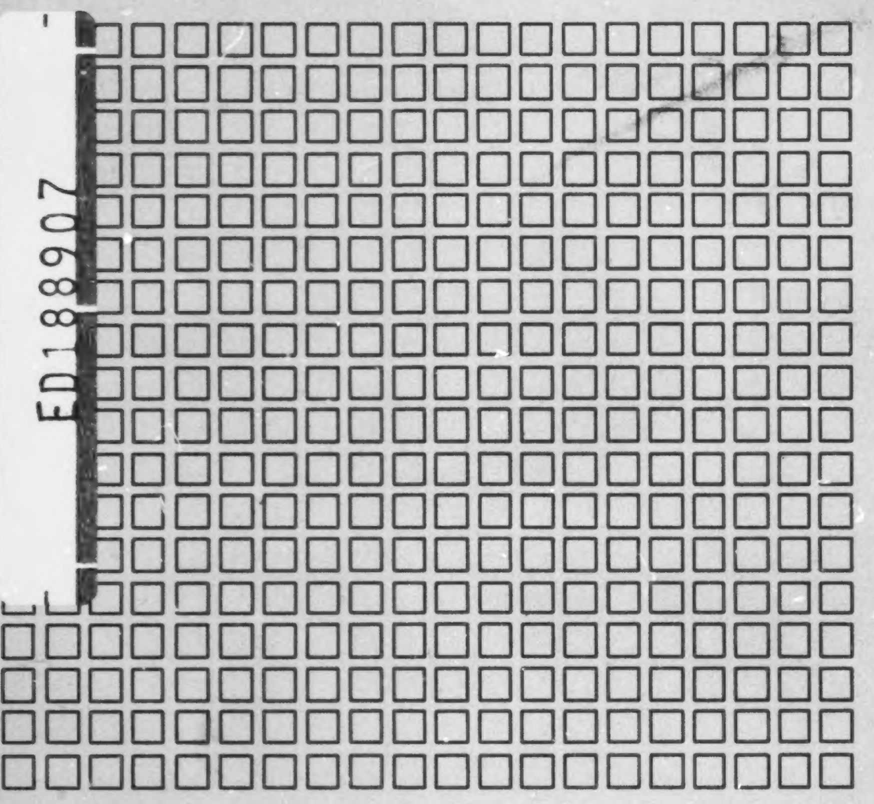

Source Book of Projects Science Education Development and Research

Fiscal Year 1979
With References to Earlier Years

U.S. DEPARTMENT OF HEALTH,
EDUCATION & WELFARE
NATIONAL INSTITUTE OF
EDUCATION

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National Science Foundation
Directorate for Science Education
Division of Science Education Development and Research

SE 031 218

The reader is reminded that the primary source of further information on a project is the Principal Investigator in each instance, who may be reached at the academic address given. Final reports are not due from projects until six months following the termination date.

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FOREWORD

The National Science Foundation's Science Education Directorate has the responsibility for enhancing the vitality of all levels of science instruction across the Nation. The two major goals of the Directorate are:

- To help *all citizens* increase their basic understanding of science and its contributions to the quality of life; and
- To assure a stable flow of the most talented students into *careers* in the sciences, with particular reference to increasing the participation of minorities and women.

Science education research and development support are two of the principal mechanisms the Foundation uses to implement these goals. The aim of this support is to develop new knowledge and new means for improving science education. Innovation, transferability, and potential for widespread impact are especially characteristic of development projects, while usable results are important to the research program.

The purpose of this document is to promote awareness of and interest in recent activities in science education development and research. We hope it is useful to a variety of groups including developers and researchers, future proposers to the Foundation, and teachers of science at all levels.

F. Jim Rutherford

F. James Rutherford
Assistant Director
for Science Education

INTRODUCTION

The objectives of the Division of Science Education Development and Research (SEDR) are to develop new means for improving science education at all levels, and to further the basic understanding of science teaching and learning. Progress is sought by:

- Developing innovative technologies, instructional materials, methods of instruction, and ways to increase participation in science; and
- Generating new knowledge and theory as a basis for improvements in science education.

The quality of life increasingly depends on science and its related technology. The health of science, in turn, depends on the quality of science education. Due to rapid changes in science and society, science education must be continually modified through development and research. Both are needed to introduce new knowledge into the educational process, to prepare people for new science-related tasks and problems, to translate scientific knowledge into a form that can be understood and learned, and to capitalize upon new insights into the way we learn. Both development and research in science education are needed to assure that people will be able to cope with and enjoy the benefits of our technologically-based society.

The SEDR Division is currently targeting several areas of emphasis which relate directly to the goals stated in the Foreword for the Foundation's Directorate for Science Education.

For *both* development and research these areas of emphasis include:

- *Science Literacy*—and the Relation of Science to Society—To assist all citizens in coping with and enjoying both our technological society and the natural world, and to understand the relationships at the interface of science and society.
- *Career Access*—With special concern for participation of minorities, women, and the physically handicapped, to assure a stable flow of talented individuals into science careers, and to maintain their effectiveness through continuing education.
- *Early Adolescence*—This age group is also highlighted in the other areas of emphasis because of the importance and

past neglect of junior high school science instruction. It is at this age that most U.S. children receive their *last* formal science instruction.

- *Technology in Science Education*—To exploit the potential of the rapidly advancing information technologies for improving science (especially mathematics) learning, and to help people use these technologies effectively.

Also pervading both development and research activities is an increasing concern with efforts to disseminate knowledge generated by these activities to those responsible for science education. This document is made available as one response to this concern. It is expected that the information it contains will be interesting to a spectrum of person concerned with science education at all levels.

Joseph I. Lipson

Joseph I. Lipson
Division Director

USING PUBLICATION SE 80-80

This publication describes awards made in the National Science Foundation's Division of Science Education Development and Research in Fiscal Year 1979, in Fiscal Year 1978, and in earlier years.

Sections I and II are the central part of this publication and all other parts are indexes to these sections.

Section I. *Projects awarded in Fiscal Year 1979 in the Development in Science Education (DISE) Program and the Research in Science Education (RISE) Program.* A summary description of each project is provided, along with the name and address of the Principal Investigator, the amount of funding, and the duration of the project. DISE Program project descriptions begin on page 1; RISE Program project descriptions begin on page 50. Projects appear alphabetically by State and Institution beginning with Alaska (page 1) and ending with Wisconsin (page 90).

Section II. *Projects awarded in Fiscal Year 1978 and in earlier years in the Development in Science Education (DISE) Program and the Research in Science Education (RISE) Program.* The title of the project and the name and address of the Principal Investigator are provided. Section II may be used with the Key Word/Phrase Index to locate the titles of projects initially supported in FY 1978 or earlier.

A summary description of each project, and funding and duration information may be obtained by requesting publication SE 79-80 from Forms and Publications, National Science Foundation, Washington, DC 20550.

DISE Program project titles begin on page 92; RISE Program project titles begin on page 114.

Section III. *Key Word/Phrase Index.* This index is an alphabetical listing of salient words and phrases derived from all project summaries of awards made in the Development in Science Education (DISE) Program and the Research in Science Education (RISE) Program in FY 1979, in FY 1978, and in earlier years.

The Key Word/Phrase Index allows the reader to locate projects concerned with particular areas of interest. For example, *Expert-Novice Studies* or *Computer-Assisted Instruction* have several page references each, referring to projects that are concerned with those subjects. Page references are keyed to the roster of FY 1979 awards beginning on page 1, or to the FY 1978 and earlier awards beginning on page 92.

It should be noted that *summary descriptions* are provided of projects awarded in FY 1979, but only *titles* are shown of projects awarded in FY 1978 and earlier. Summary descriptions for FY 1978 and earlier projects may be obtained by requesting publication SE 79-80 from Forms and Publications, National Science Foundation, Washington, DC 20550.

Section IV. *Principal Investigators of Projects Awarded in Fiscal Year 1979, by State and Institution.* This section is provided as an index to location of projects. It is an alphabetical listing of States, and under each State are given the Institutions and Principal Investigators whose projects were awarded during FY 1979.

Page references are to pages in this publication, SE 80-80, and refer the reader to summary descriptions of projects awarded during FY 1979.

Section V. *Principal Investigators of Projects Awarded in Fiscal Year 1978 and in Earlier Years, by State and Institution.* Like Section IV, this section is provided as an index to location of projects. It is an alphabetical listing of States and under each State are given the Institutions and Principal Investigators whose projects were awarded during FY 1978 and earlier years, under the DISE and RISE Programs.

Page references are to pages in this publication, SE 80-80, and refer the reader to titles of projects awarded in FY 1978 and in earlier years. The names and addresses of the Principal Investigators are provided as well, but for summary descriptions, funding, and duration details, send for publication SE 79-80 from Forms and Publications, National Science Foundation, Washington, DC 20550.

The reader is reminded that the primary source of further information on a project is the Principal Investigator in each instance, who may be reached at the academic address given. Final reports are not due from projects until six months following the termination date.

Section VI. *Principal Investigators, Alphabetically.* This section is provided as an additional index to projects awarded in FY 1979, in FY 1978, and in earlier years.

Page references are to projects in this publication, SE 80-60, with FY 1979 projects beginning on page 1 and FY 1978 and earlier years beginning on page 92.

Data for this report were taken from program records and therefore may differ from official National Science Foundation source documents which are generated from the Management Information System data base which may contain different inclusions/exclusions.

SECTION I

Projects Awarded
Fiscal Year 1979

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SE 80-80

Scientist-in-Residence in Eskimo/Indian High Schools

Raymond P. Bailey
University of Alaska
Fairbanks, Alaska 99701

This project will develop a "Scientist-in-Residence" model as an approach to science education enrichment for secondary schools serving sizable populations of minority students. Each month through the academic year, a University-based scientist will make a four- to six-day visit to participating schools. Individual scientists representing different scientific disciplines will visit the schools one or more times in each year of the project. The visiting scientist will participate in both classroom science activities and informal interactions with students. He/she will provide in-service training for local teachers in the use of local conditions (environment, culture, student interests, available resources) to illustrate and teach scientific principles. Promising students will be invited to participate in summer internships, either in research laboratories or at scientific field sites.

Investigators believe the closer personal contact between students and scientists of many disciplines will encourage interest in science, will improve students' academic performance, and will later increase their representation in the scientific professions.

$125,100
Awarded: 08-21-79
Terminates: 02-28-82

SED 79-19009
NSF Program Manager:
Linda Kahan
Development in Science Education

Physical Science Activities in Out-of-School Settings for Early Adolescents and Their Families

Alan J. Friedman
University of California
Berkeley, California 94720

This project will develop a series of 16-20 physical science activities for use in informal settings with early adolescents (ages 11-14) over a 2-year period. The set of activities to be developed during the year will be concerned with the "Physics of Sports." Later topics will include the "Flight of Airplanes and Birds" and "Geology for Backpackers."

Three different user groups will evaluate each trial set of activities. During each of three sequential evaluations, the project evaluator will assess user attraction to and satisfaction with materials, the extent of resulting use, and the materials effectiveness in meeting specific learning objectives for each activity.

Materials will be disseminated to increasingly larger trial groups during the product's evaluation stages and commercial production and distribution of the project will be sought for 1981. The strategy selected for accomplishing the ultimate goal of widespread distribution will depend upon factors such as the amount and type of information dissemination required and the nature of the target population for which the materials are intended.

$226,100
Awarded: 08-30-79
Terminates: 07-31-82

SED 79-19011
NSF Program Manager:
Linda Kahan
Development in Science Education

Materials and Strategies to Improve Women's Access to Scientific Careers

Robert Karplus
University of California
M-11 Wheeler Hall
Berkeley, California 94720

This project will develop, test, and evaluate materials designed to: develop mathematics problem-solving skills in students, aged 10-15 years; increase students' knowledge, awareness, and understanding of the relationship of problem solving to scientific activity; increase students' understanding of the relevance of mathematics coursetaking to career options in adulthood; and improve students' attitudes toward the study of mathematics.

The project addresses the problem of lack of participation by young women in high school math and science courses, and their subsequent underrepresentation in scientific and technical fields of study and work. By developing innovative activities that promote student interest and competence in mathematics, as well as increasing knowledge and motivation about opportunities for women in scientific fields, the project expects to intervene in the cycle of math avoidance that has created barriers to the full participation of women in the sciences.

Project materials will consist of two handbooks: one consisting of 30 activities for use in classrooms and informal learning settings, as well as in in-service teacher education programs. The second, an implementation guide, will assist educators in integrating the activities into a standard mathematics curriculum, an in-service teacher education program, or a series of workshops for youth groups.

$174,409
Awarded: 08-17-79
Terminates: 03-31-82

SED 79-18980
NSF Program Manager:
Linda Kahan
Development in Science Education

Development of Reasoning Skills in Early Adolescence

Alfred M. Bork
University of California
Irvine, California 92717

This project explores potential applications of inexpensive computers to promoting the development of reasoning in students aged 13 to 15. It is based upon two areas of similar work: non-computer materials in physical science for these ages, and computerized materials for beginning college students. Three considerations motivate the project: 1) the increasing availability of powerful, inexpensive computers; 2) the growing perception that many students never develop a comfortable competence in using abstract thought; and 3) the fact that while abstract thought is essential to understanding concrete reality, people at large do not employ it effectively.

The objective over the next two years is to explore the possibility that the time is now ripe to make significant progress in creating products which will 1) lay out different approaches to the goal of improving general facility in abstract thought; 2) demonstrate effectiveness of these approaches; and 3) allow better evaluation of whether further steps should be taken, and if so, which steps.

Anticipated products include: 1) surveys of computerized materials stemming from various learning and teaching theories for early adolescence and from computer-aided evaluations of the effectiveness of materials; 2) analyses of how different reasoning skills relate to the curriculum and overall educational goals; and 3) computer programs showing teachers how to use these materials or how to generate their own.

$179,000 SED 79-19021
Awarded: 08-30-79 NSF Program Manager:
Terminates: 06-30-82 Gregg Edwards
Development in Science Education

Role Models for Adolescent Girls in Science and Math

Jane Permaul
University of California
UCLA Office of Experimental Educational Programs
405 Hilgard Avenue
Los Angeles, California 90024

The goal of this project is to develop, test, and disseminate information about an easily replicable model program that will increase science/math career awareness among junior high school girls, especially girls from schools with large ethnic minority populations.

Twenty-four UCLA female undergraduate science majors (including a high proportion of minority women) will be selected and trained to serve as role models in junior high schools. After receiving 20 hours of training, the students will form five teams, and each team will lead science career workshops for girls at four schools. Each undergraduate will give 24 additional hours of service in appropriate formats, such as participation at science club meetings or work with the school guidance counselor. The project will be formally evaluated.

Project results will be documented and disseminated through the production and distribution of a descriptive booklet, a tape-slide presentation, conference presentations, and publication in a professional journal.

$27,900	SED 79-19023
Awarded: 08-08-79	NSF Program Manager:
Terminates: 02-28-81	Linda Kahan
	Development in Science Education

Exhibit Development Including a Linguistic Display Area

Robert Semper
The Exploratorium
3601 Lyon Street
San Francisco, California 94123

During the coming two-year period, the Exploratorium will revise and extend its exhibit area so as to upgrade a number of exhibits on the basis of audience reactions, and to include a new area focusing on research related to linguistics. The section will include such aspects as the physics of sound production, the biological and evolutionary aspects of language, the psychology of the perception of meaning, and the expression of meaning through language. The project will involve the development of about 35 exhibit pieces and a variety of written material including appropriate take-home material.

Plans for and experience with the exhibits will be documented for use by other museums.

$366,409
Awarded: 01-17-79
Terminated: 06-30-81

OSS 78-24743
NSF Program Manager:
George W. Tressel
Development in Science Education

The Guided Design Approach to Problem Solving: A Program for Training Junior High School Science Teachers

Bernard Coyle
San Francisco State University
Frederic Burk Foundation for Education
1640 Holloway Avenue
San Francisco, California 94132

This project will develop training procedures for introducing junior high and middle school science teachers to the problem-solving approach called guided design, by holding an institute at San Francisco State University on "Energy, the Environment and Conservation," for 40 Bay Area teachers. The institute will serve as a national model, and the materials produced are intended to be useful to others in organizing similar teacher-training programs throughout the country. The guided design units developed for the institute by the staff and the participants will be tested by the teachers in their classrooms, and will be disseminated nationally. In addition, a series of "mini workshops" will be held at national meetings of teachers and science supervisors to introduce them to the approach.

Guided design is a term used to describe a particular kind of problem-solving approach to the study of a specific topic. The class is divided into small groups which are presented with an open-ended problem and are guided through the steps necessary to arrive at a decision. This, in turn, leads to a new problem to be solved. Necessary background materials are provided at appropriate times by the instructor. The key feature of guided design is the involvement of the participants in the decision-making process.

$84,400
Awarded: 08-21-79
Terminates: 02-28-82

SED 79-18972
NSF Program Manager:
M. Antoinette Schiesler
Development in Science Education

University Level, Computer-Assisted Instruction (CAI) and Computer-Generated Speech in Mathematics

Patrick Suppes
Stanford University
Stanford, California 94305

This is the third-year of a three year project concerned with performing development and research on computer-based instruction (CAI) in university-level courses, the development of efficient computer-based procedures for informal mathematical proof, and the development of effective computer-generated speech.

During the first year the mathematical proof checker system was redesigned to be interactive and to function as a theorem prover. Improvements were made in the CAI programs and new introductory lessons begun. Data compression techniques were implemented to improve the audio, and studies were conducted to improve the quality of the synthesized speech message.

During the second year the primary goal was to implement the first version of the interactive theorem prover and to extend it using data gathered from its use in class. A small machine for generating synthesized speech at remote sites (Mini-Miss) was simulated and several experiments were conducted to evaluate the quality of the speech generated.

In the third year, major efforts will be devoted to refining and extending the interactive proof programs and using and evaluating them with students. Work continues on compression and interpolation techniques for the Mini-Miss system with the aim of designing and building a high quality speech device with a transmission rate in the range of 4000 bits per second. The Mini-Miss system will be built and field-tested this year.

$1,050,000.*
Awarded: 08-08-77
Terminates: 12-31-80

SED 77-09698
NSF Program Manager:
Andrew R. Molnar
Development in Science Education

*Cumulative amount. Latest award: $349,000.

Human Sciences Program (HSP): A Three-Year Integrated Human Sciences Curriculum for Middle Schools

William V. Mayer
Biological Sciences Curriculum Study Company
P.O. Box 930
Boulder, Colorado 80302

The Human Sciences Program (HSP) is designed as an interdisciplinary science offering for middle or junior high school level (ages 11 to 14 years) and focuses on the natural sciences, including appropriate material from the social sciences. The HSP is further based upon educational theory that accommodates the needs, interests, and developmental characteristics of emerging adolescents as well as variability in the tastes of individual families and communities. Fifteen modules, each providing approximately eight weeks of classroom activities, have been developed and field-tested in representative schools across the country. C & F Associates, Inc., of Chicago, Illinois, has been selected to publish and distribute HSP; production has been initiated.

This final award provides continuing support for a number of activities essential to completing the HSP development: 1) completing analysis of the entire three-year sequence of student materials based upon data acquired during field testing; 2) continuing quality control procedures to insure accuracy, integrity, and appropriateness of the final program; 3) testing and revising management resource materials for publication; 4) completing development of student evaluation materials; 5) preparing all HSP materials for publication and commercial distribution; and 6) preparing a final evaluation report for the entire project and a documented history of HSP. Current projections call for all components to be completed by August 1980.

$3,680,932*
Awarded: 10-11-72
Terminates: 01-31-81

SED 72-06305
NSF Program Manager:
Raymond Hannapel
Development in Science Education

*Cumulative amount. Latest award: $549,900.

Innovations: The Social Consequences of Science and Technology

William V. Mayer
Biological Sciences Curriculum Study Company
P.O. Box 930
Boulder, Colorado 80302

Using previous studies carried out by the Office of Technology Assessment and the National Science Foundation, the Biological Sciences Curriculum Study Company will design, develop, and evaluate a series of curriculum resource units that help students learn about recent scientific and technological innovations and their social consequences. The materials will be designed for use primarily at the 11th or 12th grade level, either in existing science or social studies courses or as the basis for an interdisciplinary semester course dealing with the interface of science, technology, and society. Some applications to two-year college instruction are also foreseen. Students will be encouraged to address five general questions about a given technological innovation: what is it or how does it work? how does it affect me? how does it affect us? how valuable to us is it? what might be its future?

Each resource unit will utilize a variety of learning strategies and contain student materials in various combinations of print, tape, visual and "hands-on" components. As much as possible units will employ equipment typically found in the science labs of most high schools in order to keep the cost of the materials low.

Materials will be developed by teams of experts in science content and specialists in curriculum development. After appropriate testing, revision, and evaluation, nationwide distribution through a commercial publisher is planned.

$180,749
Awarded: 07-17-79
Terminates: 12-31-81

SED 79-18968
NSF Program Manager:
Gene D'Amour
Development in Science Education

Science, Society and The Senior Citizen: A Model Educational Program

Robert Larkin
University of Colorado
Austin Bluffs Parkway
Colorado Springs, Colorado 80907

This project will involve the design, development, and dissemination of a model educational program which has two primary goals: 1) in the short term, to give older students an experience of science-based interdisciplinary study, stressing the relatedness of scientific ideas and social values; 2) in the long term, to involve older people in the mainstream of higher education.

A group of teacher/counsellors—physical, biological, and social scientists, and humanists—from the University of Colorado—Colorado Springs, and Colorado College will offer a varied program of educational activities in the area of science and society. Starting out on the senior citizens' home ground, they will gradually introduce the older students into the academic programs of the two institutions.

This program is expected to appeal to those large numbers of older people who want very much to understand more about science, but who don't know how to or are afraid to begin. If successful, information about this model will be disseminated to institutions interested in starting similar programs around the Nation. A rigorous evaluation component will measure the resulting changes in skills and attitudes on the part of older people toward science education.

$135,206	SED 79-19031
Awarded: 08-31-79	NSF Program Manager:
Terminates: 03-31-82	Gene D'Amour
	Development in Science Education

Digital System Education Materials (DISEM Project)

Thomas A. Brubaker
Colorado State University
Fort Collins, Colorado 80523

The aims of this project are: (1) to survey the current content of Digital Systems Engineering (a combination of parts of electrical engineering, computer science, and engineering); (2) to assay best practice of digital systems education in 10 leading colleges, universities, industrial continuing education, and research programs; (3) to develop some prototypes of instructional materials which emphasize design and utilize computer techniques for a data-base of references to best-practice instruction; and (4) to provide estimates of the costs and benefits of an instructional system in this field, centered on a national network to exchange computer programs, product information, and teaching materials.

If the results of this project are favorable, then the experience gained could be used to formulate a somewhat larger project involving teachers and students of digital systems across the country.

$200,000	SED 79-19781
Awarded: 08-24-79	NSF Program Manager:
Terminates: 09-30-82	Gregg Edwards
	Development in Science Education

Decision-Making Modules on Public Policy Issues of Science and Technology

Irving Morrissett
Social Science Education Consortium, Inc.
855 Broadway
Boulder, Colorado 80302

Using studies completed through NSF's Ethics and Values in Science and Technology Program, the Educational Resources Center, Inc., (ERC) of Boulder, Colorado, will develop, field test, and disseminate ten decision-making simulation activities focused on public policy issues related to science and technology. The broad goal of the proposed project is to enhance junior high and high school students' understanding of appropriate science content and to develop the skills and discipline required to make informed and responsible public policy decisions. Each simulation will include a teacher's guide, background information for students, role cards, and a data packet of documents that can be used to support or challenge arguments.

A team of consultants will assist the project staff to identify key social and physical science concepts, analyze value positions, and define the roles of various decisionmakers. The consultants will also review the materials for soundness of content and teaching strategies. A training kit designed to help teachers use the simulations effectively will also be developed and produced by the project staff. The simulations will be field-tested at schools in geographically diverse areas. After the simulations have been revised on the basis of field-test results, it is planned to disseminate the materials on a nationwide basis through a commercial publisher.

$245,000
Awarded: 07-31-79
Terminates: 03-31-83

SED 79-18979
NSF Program Manager:
Gene D'Amour
Development in Science Education

Secondary School Course in Applications of Mathematics to Science

Madeline P. Goodstein
Central Connecticut State College
1615 Stanley Street
New Britain, Connecticut 06050

A curriculum in mathematics for the introductory secondary quantitative sciences (chemistry, physics, parts of biology, etc.), has been developed in preliminary form and will be revised and piloted in a half-year course in ten schools in Connecticut under varying conditions of scheduling and instruction. The course will be taught either by science or by mathematics teachers. The goal of this interdisciplinary course is to instruct students in the calculations and understanding needed to make the transition from abstract mathematics to the kinds of applications needed in science, an area of considerable difficulty for many youngsters. An auxiliary goal is to enable the student to apply this mathematics to calculations involving proportions and ratios in daily living. The experimental group will study, with frequent use of concrete exemplars, the ways in which natural variables can be related through rates, ratios, dimensional analysis, direct and inverse proportions, and graphs. Achievement will be evaluated in both the experimental curriculum and the subsequent science course. A student textbook and teacher's guidebook suitable for commercial publication will be produced by this project.

$130,070	SED 77-18444
Awarded: 09-08-77	NSF Program Manager:
Terminates: 02-28-82	Linda Kahan
	Development in Science Education

Conservation Classroom Program (Advanced)

Margaret Rosenberry
National Wildlife Federation
1412 - 16th Street, N.W.
Washington, DC 20036

The project will bring into middle and junior high schools high-quality, ready-to-use environmental science curriculum materials that teach students about environmental science concepts and that develop an awareness and appreciation for the natural environment.

The project will develop a classroom program in conservation specifically for early adolescent learners. Participation in the program by teachers will be voluntary, and will be encouraged through the use of teacher and student incentives (certificates, awards, etc.). The materials supplied to the teachers will promote investigative activities that teach scientific processes and environmental concepts and will suggest specific projects that students may undertake to enhance/maintain the natural environment in their own areas.

$286,200	SED 79-19015
Awarded: 08-29-79	NSF Program Manager:
Terminates: 03-31-82	M. Antoinette Schiesler
	Development in Science Education

Toward Improved Candid Classroom Instructional Television: Guidelines for Program Evaluation and Production

Charles Hutchinson
Association for Media-based Continuing Engineering Education
Georgia Institute of Technology
Atlanta, Georgia 30332

The purpose of this project is to improve the quality of televised instruction originating in university ITV classrooms for transmission to off-campus professionals. The premise is that most, if not all, ITV operations could upgrade both facilities and training of camera operators and instructors with modest investments of time and local money. The key is to provide national ITV centers with standardized instruments to guide the production and evaluate the quality of intructional video tapes.

Toward this end, three standardized, mutually consistent instruments will be developed: 1) detailed criteria for the assessment of video tape quality; 2) an instructional tape that communicates these criteria and gives guidance to producers; and 3) a questionnaire that will allow potential users to evaluate video courses as to their technical, professional, and instructional quality.

These instruments will be derived from an authoritative study of current literature, professional ITV producers' opinions, and students' and employers' views on instructional effectiveness. Resultant materials will be pilot-tested for validity and then widely disseminated.

$132,640
Awarded: 09-06-79
Terminates: 03-31-82

SED 79-19041
NSF Program Manager:
Gene D'Amour
Development in Science Education

University Consortium to Increase National Effectiveness of Continuing Education for Engineers

Charles R. Vail
Association for Media-based Continuing
Education for Engineers, Inc.
Georgia Institute of Technology
Atlanta, Georgia 30332

The Association for Media-Based Continuing Education for Engineers, Inc., (AMCEE) is a consortium of 19 universities formed to increase, nationwide, the range and effectiveness of continuing education for practicing engineers. Funds for course materials development are provided by a revolving-fund grant from the Sloan Foundation. NSF support is for organizational development—to create a self-continuing mechanism by which academic institutions can coordinate their efforts in the management, development, exchange and delivery of video-based instructional materials for engineers. Sloan money creates the materials; NSF's develops the sharing and distribution mechanism.

In FY 1979, NSF funds supported AMCEE in the institution of an organizational structure designed, with the cooperation of industry, professional societies, and academia, to be responsive to the needs of engineers employed in industry. This structure included broad-based industrial-academic cooperative participation, modest needs surveys, and collaborative workshops. Formative evaluation of AMCEE's courses and distributional method was carried out. Conferences and a monthly newsletter provided information and guidance to member institutions. AMCEE's major thrust was the publication of course catalogs, describing approximately 224 courses, distributed to 28,000 potential clients.

User orientation packages, an updated, expanded general catalog and a new set of topical catalogs for specialized users are scheduled for FY 1980. Also, AMCEE expects to provide a nationwide computerized information service on continuing education for scientists and engineers and to explore alternative technological approaches (satellite and cable TV technologies) for the delivery of its video-taped courses.

$236,131
Awarded: 05-24-78
Terminates: 12-31-80

SED 77-22909
NSF Program Manager:
Gene D'Amour
Development in Science Education

Arithmetic and Its Applications

Zalman Usiskin
University of Chicago
Chicago, Illinois 60637

The three major activities of this project are: 1) to organize the many applications of common arithmetic into a detailed taxonomy (schema) and write a teacher handbook of these applications, giving specific examples; 2) to develop a sequence of instructional materials in the applications of arithmetic for average students of ages 11-14; and 3) to test the teacher handbook and student materials while they are being developed and after a finished product exists. The handbook and materials will then be disseminated to classrooms throughout the country through commerical publication. Six learning units for junior high students, based upon the schema, will be developed during the first phase of the project (two years). A projected later phase of the project would develop and test eight more units, and would involve summative evaluation and commerical publication of the materials. This award funds first-phase activity only.

$224,400
Awarded: 08-10-79
Terminates: 03-31-82

SED 79-19065
NSF Program Manager:
M. Antoinette Schiesler
Development in Science Education

Using Microcomputers to Teach Social Science in Junior and Senior High Schools

Paul Handler
University of Illinois
57 Coordinated Science Laboratory
Urbana, Illinois 61801

The aim of this project is to demonstrate and evaluate the effectiveness of small microcomputers in teaching social science in junior and senior high schools. The project is an extension of work done under an earlier NSF project which generated similar materials in demographics for college classes. The products expected are: 1) two instructional packages—including programs, teacher's guides, workbooks with completed examination questions and problems—entitled "Immigration in the U.S. (1880-1920)," and "Presidential History"; 2) a prototype "Dynamic Library" in which information will be arranged in special ways for ease of use; 3) a published article with an overview of the theoretical and practical considerations required for successful school social science computer-based learning programs; 4) a map of where in the school social studies curricula the modules can be used, and strategies for their effective use; and 5) a report on the results of an evaluation of the effectiveness of the above materials.

$50,000	SED 79-18501
Awarded: 09-11-79	NSF Program Manager:
Terminates: 12-31-81	Gregg Edwards
	Development in Science Education

Interactive Science Museum Exhibits for Preschool Children

Theodore Ansbacher
Museum of Science and Industry
57th Street and Lake Shore Drive
Chicago, Illinois 60637

This project will develop and test a total of 20 science instructional museum exhibits in four topics in the physical sciences for preschool children. These prototype exhibits will 1) allow the child to manipulate and investigate physical phenomena under safe conditions; 2) provide planned experiences that can promote ideas like cause and effect, and provide a basis for the later understanding of general principles and relationships; and 3) be suitable for relatively inexpensive duplication at other museums and at preschool facilities. In addition, the exhibits will serve as an introduction for teachers and parents to the inquiry approach to science teaching as applied to preschool children. Written materials will be developed to help the adults understand the rationale for the exhibits, and to provide suggestions for follow-up activities.

An advisory committee will be formed to provide input on exhibit design. A specialist in science and early childhood education, and one in exhibits design will work under the direct supervision of the project director. A final report will be written and distributed to museums, science centers, and preschool centers throughout the country. Detailed plans for exhibit construction will be made available on request to interested parties.

$113,600	SED 79-19038
Awarded: 08-30-79	NSF Program Manager:
Terminates: 06-30-81	M. Antoinette Schiesler
	Development in Science Education

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A Computer Conferencing System for Peer Evaluation and Commentary on Essay Tests

Jerome H. Woolpy
Earlham College
Richmond, Indiana 47374

A major aspect of the learning process involves a student's confronting some problem and generating his own answer to it for critique and commentary. However, it is difficult to provide the environment for this type of education in large undergraduate classes. The purpose of this project is to use a computer system to approximate this type of environment. The system organizes the students into three types of activities: 1) question generating; 2) answering; and 3) commentary on answers to provide for the kinds of constructed solutions to problems and cross-critique found in small seminars. For the past two years the system has been developed and used at Earlham in several courses in the natural and social sciences.

The current amendment will provide funds to package the system so that it can be transported and used in other college environments. The current system is written in Standard FORTRAN and documented according to CONDUIT standards which increase its transportability. Equipment will also be installed to permit off-campus use via telephone.

$10,300	SED 77-18890
Awarded: 09-21-77	NSF Program Manager:
Terminates: 02-28-81	Dorothy K. Deringer
	Development in Science Education

Global Geography Course for the Middle Grades

Howard D. Mehlinger
Indiana University
Bloomington, Indiana 47401

This project will develop, test, and disseminate instructional materials for a world geography course that incorporates a global studies perspective, for use in grade seven social studies classrooms. The instructional materials will consist of a textbook and teacher's guide. The course will be designed for use as a complete two-semester offering and give local schools a new alternative to existing geography and area studies programs at the junior high/middle school level.

A global studies perspective may be defined as one that: 1) emphasizes interdependence among people and places, resulting from resource and technological differences among them; 2) emphasizes the trend toward similarity among people and places, resulting from the rapid spread of ideas; and 3) emphasizes the local, regional, and global impact of people on places, resulting from decisions they make. This project will provide young adolescents with sound social science instruction that emphasizes the impact of science and technology on society. Commercial publication of these instructional materials is planned.

$215,700
Awarded: 09-05-79
Terminates: 12-31-81

SED 79-18988
NSF Program Manager:
Linda Kahan
Development in Science Education

Use of Microcomputers for Learning Science

James W. Johnson
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Iowa City, Iowa 52242

The purpose of this project is to develop and disseminate instructional materials for college-level science instruction which take advantage of features available in microcomputer-based systems. The work will be done by CONDUIT, an organization which facilitates the transfer of computer-based instructional materials among colleges and universities.

Four teams of scientists and authors (mathematics, chemistry, physics, and biology) will select materials and modify them with the assistance of CONDUIT staff. An example of a package for chemistry is a qualitative analysis module which teaches strategies for determining organic compounds by having chemistry students perform simulated laboratory tests on an unknown substance. Effective strategies are reinforced by providing students with costs of tests and critiques of the methodology employed.

The materials will be tested in a classroom situation and be evaluated by peers to determine their usefulness in teaching science and the effectiveness of features such as graphic displays, audio response, sound effects, and time-limited response.

Twenty units will be selected for nationwide dissemination. It is anticipated, based upon CONDUIT's past experience, that instructors at over 100 institutions of higher learning will choose to use each of these units. Adopters will pay for the full costs of distribution.

$313,600 SED 79-19025
Awarded: 08-17-79 NSF Program Manager:
Terminates: 02-28-83 Dorothy K. Deringer
Development in Science Education

Career Oriented Modules to Explore Topics in Science (COMETS)

Walter S. Smith
University of Kansas
Lawrence, Kansas 66045

Career Oriented Modules to Explore Topics in Science (COMETS) will develop, test, and evaluate an instructional package that teachers of young adolescents can use to bring women role models—women who have scientific careers—into the science classroom. The purpose of the project is to dispel the young adolescent girls' perception of lack of utility and relevance of math and science courses, and both girls' and boys' stereotypes of science as a career only for men.

The package will consist of 24 supplemental instructional units, a set of biographical sketches of women with science-related careers, and five "how-to" booklets addressed separately to teachers, counselors, school administrators, parents, and role models. The role models will use the units in the classroom to teach science topics related to their own career. The units will cover a spectrum of scientific disciplines, but will emphasize physical science topics.

This project is the first phase of a planned two-phase project. In phase II the materials would be nationally tested and disseminated. Commercial publication of the materials will be sought.

$119,765
Awarded: 08-28-79
Terminates: 03-31-32

SED 79-19006
NSF Program Manager:
Linda Kahan
Development in Science Education

The Modular Course in Electronic Instrumentation (ME) Final Phase

Robert F. Tinker
Technical Education Research Centers
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This is the final phase of development of the Modular Course in Electronic Instrumentation. Twenty-six modules that use a hands-on laboratory approach to teach students various aspects of electronic instrumentation were developed in the first phase of this project. This series of modules constitutes a flexible instructional system. Introductory lessons teach basic instrumentation concepts, especially useful for technologists and others who are primarily users of oscilloscopes, voltmeters, simulators, and similar electronic instruments. More sophisticated modules in the series are designed for science students, system designers, and researchers to teach them how to design and test the electronic instrumentation needed in their work.

In the current phase, the existing 26 modules will be field tested, revised, evaluated, and disseminated. To increase the potential for wide-scale use of the material, six new modules will be added that cover additional aspects of the design and control of electronic instrumentation. (This is a modification of the original proposal's plan to develop 12 new modules.) Studies of the feasibility of microcomputer-based electronic text editing, production, and dissemination will also be undertaken using material from the module series. In addition, various avenues for increasing the dissemination of the materials will be developed and explored.

$254,040
Awarded: 07-26-79
Terminates: 12-31-81

SED 79-06101
NSF Program Manager:
Dorothy K. Deringer
Development in Science Education

Development of Science Materials for Early Adolescent Minority Students

Claudia B. Douglass
Central Michigan University
Mt. Pleasant, Michigan 48559

This project will produce, evaluate, and disseminate a set of 10 audio-tutorial units (audio-tapes plus workbooks) in science (biology, physics, chemistry, and geology) designed especially for the inner city early adolescent student. Each unit will begin with an appropriate attention-capturing activity to provide a concrete experience and to motivate the student. The units will be self-paced, using a mastery format so that both slower and more able students may benefit. In addition, two instructional sequences will be prepared for each unit. One will present the concepts in an inductive manner, the other in a deductive manner. Tests of thinking style will be administered to the sutdents, and the sequence that is most likely to be of benefit will be assigned to each student. Whenever possible, each unit will use examples drawn from the everyday life of the inner city early adolescent student. Each unit will also include relevant references to careers related to the science being studied. Along with the production of the units themselves, the project will produce and evaluate a set of implementation procedures to insure that the units are easily and effectively used in the classroom. These materials will detail procedures by which minority role models, who have chosen careers in science or in science-related areas, can be invited into the classroom to supplement the career aspects of the modules.

$130,000	SED 79-19024
Awarded: 08-10-79	NSF Program Manager:
Terminates: 02-28-83	M. Antoinette Schiesler
	Development in Science Education

Impact of Microcomputers on Teaching Math and Science to Junior High School Students

Herman D. Hughes
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East Lansing, Michigan 48824

This two-year project focuses on the development of materials which make use of low-cost microcomputers for teaching basic problem-solving skills in junior high school mathematics and science. Tutorial programs and teacher oriented materials for mathematics and physical science will be developed, tested, evaluated, and documented for use on microcomputers. This project also seeks to establish a mechanism for increasing an awareness of scientific careers among junior high school minorities, girls, and their parents. A pilot group of 40 seventh and eighth grade students (minorities and girls) from four junior high-schools in the Lansing area will be chosen to participate in the project. Each participating school will have five microcomputers for its use. Ten students will meet at Michigan State University for one three-hour period each week for a total of 30 weeks. This project also involves the students' math/science teachers, counselors, principals, and parents.

$104,600
Awarded: 08-10-79
Terminates: 02-28-82

SED 79-19045
NSF Program Manager:
Dorothy K. Deringer
Development in Science Education

Preparation of Supplemental Instructional Units Based on Current Crustal Research, Grades 8-10

Edward C. Stoever
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Cape Girardeau, Missouri 63701

This project is for the development, as supplements to existing curricula in grades 8-10, of a set of one to three day instructional units which are based on current scientific research into the composition, history, and processes of the earth's crust and the applications of this knowledge.

This project is intended to provide one model for shortening the time lag for translation of ongoing research into useful classroom materials. Supplements will be designed to be low cost, activity-oriented, adaptable to a variety of subjects, and will stress human implications of content. Development will be conducted at several sites by teams consisting of researchers knowledgeable in current work in crustal evolution, local classroom teachers, and other experts.

During the first two years of the project, approximately 68 units were prepared for the initial field testing. Plans for arranging for publication were also implemented. In the third year of the project, the final large-scale classroom testing of the units is being completed, an introductory teacher packet to support utilization of the modules is being prepared, and preparation of modules for commercial publication is being completed. Some 30 to 50 units eventually will be commercially published.

$188,040
Awarded: 09-12-78
Terminates: 07-31-80

SED 78-25104
NSF Program Manager:
Linda Kahan
Development in Science Education

Low Cost Approach to Videodisc Education

Robert G. Fuller
University of Nebraska
Lincoln, Nebraska 68508

During the initial phase of this project a physical science videodisc will be produced for college classroom use. It will be usable on an optical videodisc player which has random access and a 1023 programming step capability. The videodisc will be made by three college physics professors, primarily from existing physical science audio-visual materials. The project will use the videodisc production facility at the Nebraska Educational Television Center.

During the second phase of this project, the videodisc will be used in college classrooms. It will be evaluated as a learning tool both for content mastery and for generating interest. The content mastery will be evaluated using pre-test/post-test measures on experimental and control groups of students at three different midwest post secondary institutions. Student interest in learning by means of this videodisc will also be assessed.

$60,000
Awarded: 07-17-79
Terminates: 02-28-82

SED 79-19020
NSF Program Manager:
Dorothy K. Deringer
Development in Science Education

New Undergraduate Engineering Materials—Computer Models in the Context of Competing Social Values

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Princeton, New Jersey 08540

The primary objective of this work is to develop approximately 15 case-studies in which models have been used as the basis for decisions involving engineering and science projects. The emphasis will be placed upon the role of underlying values in affecting the resulting model, and by implication, the conclusions reached. Whenever possible two or more competing models with diverse characteristics will be designed for a single application. By evaluating alternatives the students will begin to appreciate the underlying (often implied) assumptions and the effect of these assumptions on the results. Evaluations will concentrate on, but not be limited to, computer-based models.

The subject matter of the cases will include a variety of topics relevant to engineering and public policy such as peak load capacity of a public utility, economic and environmental consequences of plant location and plant waste disposal, and highway transportation planning.

These cases will be tested in a new undergraduate engineering course at Princeton University entitled "Strategies in Model Management." Pedagogical comments and detailed analyses will be included in accompanying teaching notes for individual cases. An important component of the project will be a critical evaluation of the case materials by students, by an advisory committee, and by a variety of engineering professors around the country who will pilot-test the materials. The case-studies will be revised according to the comments of these groups. The case studies, teaching notes, and computer programs will be widely disseminated to educators as part of the project.

$92,000
Awarded: 08-23-79
Terminates: 02-28-82

SED 79-18998
NSF Program Manager:
Gene D'Amour
Development in Science Education

Professional Competence Development in the Undergraduate Engineering Curriculum

Jean LeMee
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This project will design, develop, and evaluate the first stage of a model curriculum in which engineers are trained to understand and communicate the broad, social-humanistic context in which society's technological problems occur. The goals of this curriculum are based on a two-year planning project in which faculty, academic administrators, and industrial engineers surveyed a wide range of attempts to clearly specify, in the form of competencies, those skills necessary to be an effective practicing engineer. In this current phase of funding, a number of assessment instruments—developed by the American College Testing Service—will be utilized to effectuate a portion of the proposed curriculum focused on problem-solving, values clarification, and communication skills.

Cooper Union faculty will work with experts in instructional development, competency-based curricula, and educational evaluation: 1) to state competence levels and develop assessment criteria; 2) prepare appropriate learning activities, study guides, and teaching materials that will enable students to attain competence criteria; 3) train faculty who will use these materials in eight existing traditional engineering courses; 4) develop formative and summative assessment instruments; and 5) provide workshops to other engineering institutions desiring the resultant material and/or techniques.

$116,900
Awarded: 08-28-79
Terminates: 02-28-81

SED 79-19004
NSF Program Manager:
Gene D'Amour
Development in Science Education

On Using Program Verifiers in Elementary Computer Programming Instruction

Robert L. Constable
Cornell University
Ithaca, New York 14850

The primary goal in computer programming is writing a logically correct program. This art is also one of the most difficult to teach. This project will explore the uses of a new tool, a program verifier, to enable students to improve their abilities to write logically correct programs. Detailed course material will be prepared for an elementary programming course which will be taught for one semester.

The program verifier offers a unique application of technology to learning. This verifier is a low cost proof checker and can be heavily used in instructional environments. It is inexpensive because the user must supply proofs; these proofs concretely represent the knowledge a beginning programmer must understand.

This program verifier is written to be used with an educational version (PL/CS) of a popular programming language, PL/I. At least 50 universities have a PL/CS compiler. The verifier, PL/CV, will be widely available (for a nominal fee) by the time the experiment at Cornell is completed.

$73,400
Awarded: 08-07-79
Terminates: 08-31-81

SED 79-18966
NSF Program Manager:
Dorothy K. Deringer
Development in Science Education

Validation of the Continuing Educational Achievement of Professional Engineers

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Institute of Electrical and
Electronics Engineers, Inc.
345 East 47th Street
New York, New York 10017

The Institute for Electrical and Electronics Engineers (IEEE) proposes to design, develop, and disseminate a model system for validating educational achievement in the area of the continuing education of engineers.

This system will consist of the following steps: 1) any institution may submit a course evaluation package to the IEEE Technical Advisory Board for review by professional engineers; 2) if accepted, the course will be assigned Continuing Education Achievement Units (CEAU's); 3) any interested electrical engineer (EE) may inform the IEEE of his or her intent to participate in the program and be entered into a computer-based record keeping system; 4) the participating EE will then take an acceptable course and his or her achievement will be evaluated by the course instructor; 5) the results will be transmitted to the IEEE for recording; 6) the participating EE will evaluate each course upon completion for quality and usefulness and inform the IEEE; and 7) the IEEE will send to the participant a dated coupon upon successful course completion indicating the number of CEAU's earned.

After earning a specified number of CEAU's, the engineer will receive a Certificate of Achievement. The long range goal of the project will be to base these Certificates on the actual attainment of engineering competence and examine the extent to which this type of system might be compatible with the goals of various bodies currently involved with the recertification of engineers.

$123,948
Awarded: 09-11-79
Terminates: 02-28-82

SED 79-18989
NSF Program Manager:
Gene D'Amour
Development in Science Education

Computer Graphics in Engineering Education

Michael Wozny
Rensselaer Polytechnic Institute
Troy, New York 12181

The aims of this first phase project are, first, to provide a detailed survey of the status and needs of university and continuing engineering education in the application of the new techniques of computer graphics and design aids; second, develop prototype materials and software illustrating their use; third, develop standards and mechanisms for sharing materials; and fourth, with a new evaluation scheme, field-test the results to indicate the likely costs and benefits. Later phases, which would have to be justified partly by the results of these trials, would extend the range of materials and organize an ongoing consortium of interested educators.

The major increases in industrial productivity provided by computer-aided design (CAD) and computer-aided manufacturing (CAM) have led many of the larger high-technology firms to make a major switch to its use as their fundamental mode of engineering practice; many small companies are beginning to use less sophisticated versions in order to maintain a competitive edge in the world market. But very few of our schools can afford to teach, and few older engineers can afford to learn these major shifts in practice and approach. The results of the first phase are designed to provide a basis for evaluating the significance of these new techniques for engineering education, and to develop a mechanism by which educational programs might more easily adopt them into their curricula but within their limited budgets.

$125,000	SED 79-20085
Awarded: 08-23-79	NSF Program Manager:
Terminates: 09-30-81	Gregg Edwards
	Development in Science Education

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Tutorial Review Articles to Update Collegiate Physics Instruction

John S. Rigden
American Association of Physics Teachers
Graduate Physics Building,
State University of New York
Stony Brook, New York 11794

The aim of this project is to help college instructors of physics keep up with new discoveries and ideas in their field, and thereby update their course content. A series of expository articles will be written by scientists who have contributed to new developments. The articles will be distinguished from currently available materials in several ways; they will be written at the level of a college teacher generally knowledgeable of the broad field, but reading outside previous specialization. They will contain discussions, illustrations, and derivations which can be immediately used in a class lecture. They will fill the gap between highly abstract research review articles and non-quantitative popular reviews in large distribution magazines.

At least four articles will be published, each containing the material sufficient for several lectures. They will be distributed both in a major teaching journal and as "separates." Other products of the project will include: an evaluation of project procedures and impacts—including a comparison of the two modes of distribution; a report on the best practice by other groups with similar problems and operations; and a report on the new practices developed in a form that other groups might adapt.

$9,900
Awarded: 09-11-79
Terminates: 06-30-82

SED 79-20223
NSF Program Manager:
Gregg Edwards
Development in Science Education

Societal Issue-Oriented Physics Modules Project

Arnold A. Strassenburg
American Association of Physics Teachers
Graduate Physics Building
State University of New York
Stony Brook, New York 11794

Eighteen instructional modules of materials on physics and physical science as related to contemporary social issues will be developed over a four-year period. Each module will be for introductory physical science courses, contain about one week of student work, and will be designed with the needs and interests of nontraditional physics students in mind (women, minorities, nonscience majors, etc.). Issues such as energy shortages, new energy technologies, and radiation safety will be covered and related to each of the major topics usually covered in introductory physics.

Sixteen of the 18 modules have been commissioned to be written by experts in the technical areas, with most now having been received in first draft and reviewed. During the coming two years, the materials will be revised, with additional material added by experts in the social policy areas and other experts in teaching the relevant physics topics. The materials will be field-tested to allow final restructuring of the modules so they will better meet the needs of the new types of students.

$110,780	SED 77-19304
Awarded: 09-28-77	NSF Program Manager:
Terminates: 03-31-82	Gregg Edwards
	Development in Science Education

Self-Instructional In-Service Program in Science Careers: Teachers of Grades 4-9

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Center for Educational Research and Evaluation
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The purpose of this project is the development and field testing of a transportable in-service training program for use by teachers in grades 4 to 9 to attract increased numbers of women and minorities into science courses and careers. One part of the in-service program will be devoted to a description of the current status of women and minorities in the labor force. The program will then focus on science careers. Since the absence of suitable role models is a significant deterrent to the participation of women and minorities in science careers, a series of posters containing pictures and profiles of typical scientists, including women and minorities, will be developed. Once an initial set of activities and materials has been completed, Research Triangle Institute (RTI) will involve a group of teachers from a local school system in revising the initial materials and developing new ones. These revised materials will be examined by an advisory committee, after which they will again be used in an in-service situation with two groups of teachers. RTI will revise the program based upon test results, observations, and teacher feedback, and will again submit the materials to the advisory committee. At this point the in-service program will be ready for use. It will, however, need summative evaluation (a process which would be accomplished in phase II of the project).

$86,300	SED 79-19001
Awarded: 08-22-79	NSF Program Manager:
Terminates: 02-28-81	Linda Kahan
	Development in Science Education

Creation, Testing, and Dissemination of Problem Solving Instructional Material - Final Phase

Richard V. Andree
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Norman, Oklahoma 73069

This project has previously received support for the development, field testing, and some revisions of five units of curriculum materials related to cryptarithms and cryptanalysis. These units have potential value as problem-solving materials for supplementing the curriculum at several points during the secondary school years. The preliminary versions of the tests and instructor's manuals have been extremely enthusiastically received by both students and teachers. The current grant will support final revisions of the materials and travel to present the ideas of the series to teachers.

$67,797
Awarded: 06-27-75
Terminates: 06-30-80

SED 75-02213
NSF Program Manager:
Dorothy K. Deringer
Development in Science Education

The Interactive Classroom: A Cost-Effective Approach to Inventive Learning

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Fifth Avenue
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This project will develop a microcomputer-based environment that offers the promise of teaching college-level students in applied math/computer science to engage successfully in multilevel model building. Rather than replicating lecture/laboratory or tutorial formats, this system will be designed to stimulate inventive learning directly by presenting students with problems that must be solved both on a local level (on an individual microcomputer) and at a higher level (with several microcomputers interacting). For example, each student might design a program to model the working of a small business on an individual computer, and also create a higher level program that controls the interaction of each of the individual business models in a larger economic system.

In this phase of the project, a small working prototype of the educational system will be developed and refined. Projected phases II and III would involve expansion of the system to cost-effective size, expansion to the application areas of science, and examination of the relative contributions of scientists explicitly trained in complex model building. This award funds first-phase activity only.

$174,900	SED 79-19007
Awarded: 08-13-79	NSF Program Manager:
Terminates: 10-31-82	Gregg Edwards
	Development in Science Education

High School Computer Science Education

J. M. Moshell
University of Tennessee
Knoxville, Tennessee 37916

To reduce computer and math anxiety and to teach instructional programming and problem-solving skills are the goals of this high school development project. Designed for average students rather than "whiz kids," the one-semester course centers around color television microcomputer graphics. Simple games lead students to picture drawing, stick-figure puppet-show cartoon creation, and to develop their ideas of an automatic cartoon procedure or program. After graphics experiences link students and computer in a play relationship, symbolic programming skills are introduced, using a structured dialect of BASIC (a computer language).

The project employs existing microcomputer hardware and software selected for transportability to different computers. High school teachers and computer scientists will prepare workbooks, lesson plans, and programs and field-test them in several high schools. The resulting curriculum and materials will be useful to teachers throughout the nation and should help enhance graphics-based teaching methods.

$206,600
Awarded: 08-20-79
Terminates: 03-31-83

SED 79-18991
NSF Program Manager:
Dorothy K. Deringer
Development in Science Education

An Associate Degree Curriculum in Solar Engineering Technology - Phase II

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This four-year project will develop a curriculum to train the technical manpower needed in the emerging solar engineering technology. The final product of this effort will be a complete curriculum package, including support courses, technical courses, staffing requirements, bibliographies, and laboratory requirements.

Phase I of the project has resulted in a curriculum package, developed and ready for pilot testing, including an established instructional philosophy, identification of student and teacher qualifications, the format for technical courses and identification of the support courses and technical courses.

During phase II, five colleges in strategic geographic locations, will pilot test the curriculum. Chosen to insure national validation of the curriculum through geographic input based on local needs, the colleges will each have a campus coordinator and faculty, with the project director at Navarro College charged with the overall responsibility. Cooperating institutions are: Brevard Community College, Cocoa, Florida; Cerro Coso Community College, Ridgecrest, California; and Navarro. In addition, Malaspino College in Nanaimo, British Columbia, will be part of the project, at their own expense.

A college network of interested institutions will be kept abreast of developments in the curriculum, will aid in formative evaluation, and be instrumental in the dissemination of the finished product.

$622,548 SED 77-12986
Awarded: 08-30-77 NSF Program Manager:
Terminates: 05-31-81 Linda Kahan
Development in Science Education

Continuing Education and College Instructional Modules in Chemical Engineering

David M. Himmelblau
(CACHE Corporation, Cambridge, MA)
University of Texas
Austin, Texas 78712

This project will extend the work of two previous projects to develop, in modular form for computer retrieval, instructional materials and computer programs covering the content of the core undergraduate Chemical Engineering (Ch.E.) curriculum, plus extensions of those programs into advanced principles and applications to make the collection appropriate for use in continuing education. The first project in 1974 developed 125 computer programs, each with about 15 pages of explanation and problems to be used in instruction; the second, in 1975-9, developed about 250 modules, each of about 25 pages, covering most Ch.E. core courses.

Over the next three years, the present project will: write or completely revise about 500 modules, fit in the preceding computer programs, give mini-study guides and explanations for 2,000 topics in computer-retrievable form, test the system in about 12 industrial and university programs and provide for electronic distribution of the results. During the first year of this project, there will be an open call for participation, task forces will be started, the computer topic-guide file will be started, the electronic distribution system will be set up in initial form, materials from the preceding project will be field-tested in a school and an industrial program, and new authors will be recruited.

$298,500
Awarded: 09-12-79
Terminates: 03-31-83

SED 79-13021
NSF Program Manager:
Gregg Edwards
Development in Science Education

Extension of TVCAI Project to Include Demonstration of Intelligent Videodisc System

Robert R. Kadesch
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Salt Lake City, Utah 84112

A demonstration of an intelligent videodisc system for science education will use a prototype system to evolve through three levels. Level 1 replaces videotape technology with that of the videodisc; at level 2, digital data are stored on and read from both videotape and videodisc; level 3 replaces the two-screen system with a single screen.

The courseware to be developed is that aleady supported under our CAUSE grant. The techniques and strategies employed in these materials put heavy emphasis upon personalized student interaction, thus making them ideal for a test of the videodisc system.

Evaluation data to be collected are to establish both hardware and software standards, evaluate cost factors, analyze authoring strategies, and finally to determine learning outcomes in actual use settings.

$119,521	SED 79-00788
Awarded: 04-01-79	NSF Program Manager:
Terminates: 09-30-81	Dorothy K.Deringer
	Development in Science Education

An Intelligent Videodisc System: Evaluation in Developmental Biology

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This project is designed to develop and evaluate a flexible, intelligent videodisc system using low-cost components chosen to be center-stream in the next five years. Text and graphics of flexible format can be generated by the computer and mixed with color videodisc pictures. Medium resolution computer graphics will be presented on a separate black and white monitor.

The course materials will support instruction in developmental biology in universities, colleges, and high schools. The basic lesson material is suitable for all three levels. The basic disc is now available and ideally suited for the addition of intelligent enhancements. The basic concepts will be elaborated in the laboratory with the videodisc providing colorful overviews of each lab session, easy access to a file of reference materials, drill and practice in basic skills, a lab tutorial, and two lab simulation packages for experiments too costly and complex to offer as a traditional student lab.

The evaluation is unique because the existing manual disc can be used as a control to assess the added value of the intelligent enhancements. The extent to which community college students are drawn into the content of the advanced simulations will be evaluated. A detailed cost analysis of courseware development, and hardware cost projections will be produced.

$386,971
Awarded: 04-01-79
Terminates: 09-30-81

SED 79-00794
NSF Program Manager:
Dorothy K. Deringer
Development in Science Education

Scientific Instrumentation Information Network and Curricula (Project SIINC)

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The aims of this project are, first, to survey the status and needs of colleges and industrial technologists for instructional materials and information on new scientific instruments, and second, to provide the needed materials via a national network of instrument users and developers.

During a first phase of three years, sample materials will be developed on four types of instruments and their uses in laboratories and industry; these will be field-tested and revised in college classrooms and in continuing education. The choices of types of instruments and kinds of materials will be based on a detailed study of current needs and best practice in the area. The materials will include: discussions of each generic type of instrument and how to mathematically model the performance of example devices; case studies of leading applications (e.g., process control) including the formulation of economic models of cost and usage factors; reviews of the scientific topics involved with an annotated bibliography, physical property data, or computer programs for the models; and instruction on how to combine the above mathematical models into a measurement strategy. Much of this information will be in a telephone-accessible computer data base for remote retrieval and updating.

The present project is limited to an exploratory development phase.

$159,700	SED 79-19780
Awarded: 09-05-79	NSF Program Manager:
Terminates: 06-30-83	Gregg Edwards
	Development in Science Education

Educating Prospective Engineers in Technology-Related Public Policy

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FS-15
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This project will design, develop, and evaluate a model program intended to enable undergraduate engineering students to understand and contribute to the analysis and resolution of technology-related public policy issues. Each summer, 15 students, chosen via nationwide competition, will participate in a 10-week course in Washington, DC, in which they will 1) attend classes focusing on the role of the professional engineer in the development of Federal, State, and local technology-related policies; 2) be assigned to a public agency for related field work; 3) contribute to a weekly seminar in which they share and analyze their field work experiences and; 4) under the supervision of a "faculty member in residence," produce case studies based on the field work experience. The case studies will be professionally revised, refined, and published.

Geographically dispersed workshops will be held to stimulate the replication of the internship model at the State level and to instigate the use of the case studies in engineering curricula.

During the first year of operation, half the student interns will be funded by engineering societies and industry; by the fourth year, the program is expected to be supported entirely by the private sector.

$226,200	SED 79-18984
Awarded: 08-31-79	NSF Program Manager:
Terminates: 03-31-83	Gene D'Amour
	Development in Science Education

Preparing Academically Disadvantaged Students in Science Through Concept-Based Modules

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This project will develop instructional materials to prepare minority and other disadvantaged students for mainstream college science courses.

The final product will be a set of instructional materials for lower division undergraduate students and accompanying guides for their instructors, organized into modules of related subject matter. The design of these materials will be guided by empirical assessment of specific difficulties which impede the progress of the students in the physical sciences. The modules will emphasize both concept formation and reasoning development. They will be designed to provide flexibility in length, choice of subject matter, and options in sequencing for courses in which they are used. They will be suitable for use by instructors in physics, chemistry, and other physical sciences at two- and four-year colleges and universities.

This is the first phase of a planned two-phase project. At the conclusion of phase I there will be a first edition of six 3- to 10-week units—enough material for about four quarters of student time. In phase II, the output of phase I would be refined, and two more units would be completed, extending subject matter coverage so that a broad range of topics would be available. At the end of phase II, curricular materials for two years of study will have been developed.

$175,770
Awarded: 07-19-79
Terminates: 02-28-82

SED 79-18997
NSF Program Manager:
Linda Kahan
Development in Science Education

Development of Video Systems for Teaching Meteorology

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The primary purpose of this project is to apply video computer systems to improve the quality of atmospheric science education. The development and testing of video computer systems for use in atmospheric science education are necessary since most weather services are modernizing communications and installing computer video display systems. University programs in atmospheric science must up-date teaching facilities to (1) accommodate the new format for classroom instruction at the graduate and undergraduate level; (2) provide and evaluate actual classroom experience using several levels of video computer capability; (3) develop an optimum system tailored to meteorological teaching requirements; (4) familiarize atmospheric science educators with the use of video computer systems; atmospheric science educators and (5) furnish technical assistance to universities seeking to install these systems. Primary emphasis upon development and evaluation of teaching aids will be in meteorology courses in synoptic laboratory, satellite applications, and the general atmospheric circulations. Various levels of capability video computer systems will be tested for both graduate and undergraduate classroom instruction to determine an optimum minimum cost system.

This is a three-year project supported jointly by the Development in Science Education (DISE) Program and by the Meteorology Program in the Directorate for Astronomical, Atmospheric, Earth and Ocean Sciences. The DISE Program is contributing $186,300 from FY 1979 funds; the Meteorology Program will supply the remaining $40,000 from FY 1980 funds.

$186,300	SED 79-19005
Awarded: 08-02-79	NSF Program Manager:
Terminates: 02-28-83	Dorothy K. Deringer
	Development in Science Education

Factors Which Influence Scientific Reasoning Among Adolescents in Natural Settings

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The generalization of instruction in scientific reasoning in classrooms to naturally occurring problems in non-school situations is a vital element of efforts to foster scientific literacy. The research will isolate factors that influence generalization of scientific reasoning to naturally occurring problems and investigate methods for fostering this process. The problem that is the focus of this research is the analysis of scientific claims in advertisements. Research will focus on how information in advertisements is extracted and used in scientific reasoning. Eight experiments will be carried out to evaluate the effects of 1) knowledge of the content area; 2) task demand; 3) social context; 4) media presentation (television, radio, print); 5) credibility of problem information; and 6) training. Findings will be verified using a variety of methodologies including naturalistic observation, interviews, and training procedures.

$182,187
Awarded: 08-21-79
Terminates: 08-31-82

SED 79-19494
NSF Program Manager:
Andrew R. Molnar
Research in Science Education

Problem Solving in Physics: Models, Experiments, and Instruction

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The proposed study seeks to formulate and test a prescriptive model specifying the aspects of human thought which underlie problem solving in a moderately complex domain such as basic physics. The resulting insights thereby gained will be used to formulate and test a model of instruction by which students can be systematically taught improved problem-solving skills.

In particular, the model to be formulated specifies 1) a general problem-solving procedure (using initial problem redescriptions and subsequent planning by succcessive refinements); and 2) a hierarchical knowledge organization facilitating such a procedure.

This model will be tested and revised on the basis of experiments in which college students are deliberately induced to act in accordance with the model for solving problems in the area of mechanics. The resulting insights will then be used to formulate a model of instruction whereby students can be systematically taught to improve their problem-solving skills. The instructional model will then be tested and revised on the basis of detailed observations of its effectiveness under controlled experimental conditions.

$121,215
Awarded: 08-24-79
Terminates: 03-31-82

SED 79-20592
NSF Program Manager:
Erik D. McWilliams
Research in Science Education

Early Adolescent Student Reasoning in Mathematics

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This project will enable a team of investigators—a physicist, a developmental psychologist, and a science educator—to do exploratory research on mathematical reasoning used by students 12 to 16 years of age.

The project staff 1) will design mathematical reasoning tasks and administer them to students in order to describe the reasoning used by these students; 2) will identify factors that enhance or inhibit performance, especially the differential effects with various subpopulations (female and minority students); 3) will analyze the instructional environment, including the most widely used textbooks and teaching strategies; and 4) will present the research findings in ways that are directly accessible to classroom teachers in addition to other research workers.

$169,000
Awarded: 08-30-79
Terminates: 03-31-82

SED 79-18962
NSF Program Manager:
Raymond Hannapel
Research in Science Education

A Study of Science Instructional Programs in Two-Year Colleges

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This is a study of curriculum and instruction in the sciences in the community, junior, and technical colleges of America. A sample of approximately 180 of the 1,213 (c. 15%) colleges, balanced by college age, emphasis, locale, size, and control, is planned. The project staff will review the literature on the sciences in two-year colleges; tabulate all courses and class sections in the sciences, social sciences, engineering, and technology in the sample of colleges; survey a random 10% of the instructors (c. 1,600) teaching in those areas; cross-tabulate findings by discipline and type of college; and prepare reports for widespread distribution.

The project will yield information on: the scope of the courses in all disciplines under NSF purview that are available to two-year college students; the magnitude of college effort in the sciences; course goals, materials, and equipment; instructional patterns; and changes in disciplinary emphases in recent years. This study will complement a similar study of humanities instruction now being conducted by the Center with support from the National Endowment for the Humanities. Findings will be of use to curriculum and instruction planners in all two-year colleges, college systems and consortia, universities, and State and Federal agencies.

$155,400	SED 77-18477
Awarded: 09-23-77	NSF Program Manager:
Terminates: 02-29-80	Raymond Hannapel
	Research in Science Education

64

Problem-Solving Processes of Upper Elementary and Junior High School Mathematics Students

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The project is a longitudinal study of the nature and development of mathematical problem-solving processes of upper elementary and junior high school students. The investigation will attempt to determine the effects of a long-term instructional program on students' ability to solve problems. The methodology to be used will be that of a "teaching experiment"—a research form popularized by Soviet researchers in which qualitative data are collected in clinical settings and protocols are recorded.

The results of the study will include extensive and descriptive longitudinal data. Protocols and analyses of students' responses will be developed for problems which have been used previously by American and Soviet researchers and also for problems which are specific to the curriculum. This data base will allow the formulation of research hypotheses to be tested in the future.

$123,320
Awarded: 08-22-79
Terminates: 02-28-82

SED 79-19617
NSF Program Manager:
Mary Budd Rowe
Research in Science Education

Expert-Novice Differences in Computer Science Problem Comprehension: Studies in Knowledge Organization

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Recent research on expert-novice differences supports the conclusion that experts and novices can be differentiated on the basis of the existing memory structures, or schemata, that they are able to apply to a problem. It has proved difficult, however, to determine the nature and content of these schemata. Although this question has not been directly addressed in research on human problem solving, methodologies for determining the form of memory structures have been developed in research on text comprehension. The goal of this research program is to adapt and extend these methodologies in order to quantify the memory structures underlying problem-solving behavior in the domain of computer science.

We will conduct a series of experiments using undergraduate and graduate students with varying levels of expertise in computer science. These experiments will examine the schemata used in this task and evaluate methodologies for categorizing the content of these memory structures. While the theoretical results of these experiments will extend current research in cognitive psychology, a successful methodology will be of empirical interest and use to a wide audience and have implications for computer science education.

$79,620	SED 79-12789
Awarded: 08-15-79	NSF Program Manager:
Terminates: 06-30-82	Erik D. McWilliams
	Research in Science Education

Funding and administration for this project are provided jointly by the National Institute of Education and by NSF under a program of research on cognitive processes and the structure of knowledge in science and mathematics.

The Relationship of Learning Styles to the Continuing Education of Graduate Engineers and Scientists

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This research effort is aimed at developing an understanding of the effect of different learning styles on the motivations of graduate engineers toward continuing education. The study will identify the relationship of different learning styles to participation in continuing education and to other variables (e.g., types of courses, blocks to learning or motivation). The results should assist in the design of continuing education programs that will better serve graduate engineers and scientists.

The research will be carried out through a sample survey involving questionnaires and psychological tests administered in about 50 different industrial settings. These tests will include measures of field independence, locus of control, and motivation toward continuing education. The data will be analyzed using a variety of statistical techniques that will identify pertinent relationships and interactions. The results will quantify the relationships of individual characteristics (such as learning styles) to participation in and demand for continuing education.

$98,700
Awarded: 09-11-79
Terminates: 02-28-81

SED 79-19945
NSF Program Manager:
Douglas B. McLeod
Research in Science Education

Support of the Planning Phase of the 1980 International Congress of Mathematics Education

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This project is designed to facilitate planning and implementation for the 1980 International Congress of Mathematics Education (ICME-4) to be held in August 1980, in Berkeley, California. The week-long quadrennial congress is sponsored by the International Commission on Mathematical Instruction to encourage dissemination of new knowledge of mathematics education and to serve as a forum for discussion of techniques of mathematics instruction among experts from a variety of countries. In particular, the congress provides an international forum for communication among researchers in mathematics education, teachers, professors, technology specialists, curriculum developers, evaluators, and government officials regarding major issues and problems in mathematics education.

This award to the National Academy of Sciences, the financial agent of ICME-4, will help defray planning costs of the congress. Primary expenditures involve travel costs of committee members planning ICME-4 and the acquisition of interpreters for the congress.

$30,000	SED 78-27458
Awarded: 03-16-79	NSF Program Manager:
Terminates: 08-31-80	Douglas B. McLeod
	Research in Science Education

68

Science Understanding in Adults Through Television

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The study is designed to assess the effectiveness with mature adults (ages 50-70) of instruction in science that is related to public policy issues. Participating in the study will be groups of mature adults in a retirement community in Florida. Three selected episodes of the NOVA television series are to be presented with specially prepared printed matter on science knowledge and tactics that undergird an important public policy issue. The effects will be compared in equivalent groups: 1) those who viewed NOVA programs; 2) those who viewed NOVA programs with supplemental instructions; and 3) those who viewed comparable non-science programs. Outcomes are to be assessed by means of a criterion-referenced test indicating understanding of the relevant science content as displayed in a fourth science program and by preferences for NOVA and other science-related programs over a three-month period. The project results are expected to shed light on the question of how specialized instruction can be used to increase scientific literacy in adults.

$145,563
Awarded: 08-29-79
Terminates: 02-28-82

SED 79-20221
NSF Program Manager:
Andrew R. Molnar
Research in Science Education

Detailed Description of Mathematical Behaviors That Demonstrate Understanding

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Mathematics teaching and testing at the pre-college level exists in, roughly, two competing forms; one characterized essentially by rote imitation of illustrative examples, and the other characterized by the (often elusive) goal of producing student understanding. For decades the distinction has been a matter of major controversy. The researchers of Brownell and others have attempted to demonstrate the superiority of understanding, but have thus far not settled the matter. Today, with the back-to-basics movement, with individualized drill and practice, and with other similar movements, the controversy is more important than ever. Fortunately, recent information-processing approaches to cognitive studies provide a new and stronger foundation for a clearer description of understanding. The proposed work observes student mathematical behavior by a careful Piagetian method, contrasts students who seem to exhibit understanding with those who do not, interprets the difference in information-processing terms, and compares the results with the expert judgment of mathematicians and experienced teachers.

$108,205	SED 79-12740
Awarded: 08-15-79	NSF Program Manager:
Terminates: 02-28-82	Erik D. McWilliams
	Research in Science Education

Funding and administration for this project are provided jointly by the National Institute of Education and by NSF, under a program of research on cognitive processes and the structure of knowledge in science and mathematics.

Effects of Topic-Specific Instructional Variables in Eighth Grade Mathematics

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The purpose of this study is to determine the effect of instructional factors on student achievement and attitude in eighth grade mathematics. The methodology will combine teacher questionnaires validated by direct observation, with student performance on achievement tests and attitude instruments administered during the Second International Mathematics Study (SIMS).

The study will employ a pre- and post-test design during one school year with intact classes to permit linking of teachers and students. The teacher questionnaires will provide detailed information on instructional activities as six mathematical topics from the eighth grade curriculum are taught: geometry; formulas and equations; ratio, proportion and percent; common fractions and decimals; measurement; integers (signed numbers). These questionnaires will not only provide much needed descriptive information on instructional practices, but are intended to relate teaching practices to growth in student achievement and student attitudes. The sample will consist of approximately 100 schools, with two classrooms per school, in four or five states selected from major regions of the United States and will be selected from the U.S. sample of SIMS.

$260,700	SED 79-17893
Awarded: 09-05-79	NSF Program Manager:
Terminates: 02-28-83	Raymond Hannapel
	Research in Science Education

71

The Feasibility of Using the National Assessment Science Data for Secondary Analysis

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This project will attempt to demonstrate the feasibility of using the National Assessment of Educational Progress (NAEP) data for secondary-analysis purposes. Over the past 10 years NAEP has gathered and reported information on the knowledge, skills, and attitudes of American 9-, 13-, and 17-year olds, and young adults ages 26 to 35.

Three research teams, working with leading science educators and with key NAEP staff members, will 1) design and make available user-oriented codebooks and data tapes containing NAEP data on achievement and attitudes in science (including mathematics and social science) education; 2) produce exemplary secondary analyses of the data on important theoretical, policy, and practical issues in science education; 3) conduct a joint conference of science educators and research team members to explore the analyses and to disseminate the substantive and methodological implications of the research; 4) train approximately 30 senior science education researchers in advanced techniques of multivariate analysis using these data sets; and 5) explore the feasibility of a national repository for data on science education which would be routinely available to future research workers for secondary analysis.

$294,500 SED 79-17259
Awarded: 08-10-79 NSF Program Manager:
Terminates: 01-31-82 Raymond Hannapel
Research in Science Education

The Role of Manipulative Aids in the Learning of Rational Numbers

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This project consists of three coordinated studies which will investigate instructional routines based on the use of manipulative aids and their effect on early adolescents' learning of rational numbers (common fractions). Reviews of research on the use of manipulative aids suggest that they can facilitate the learning of mathematics; however, research has not indicated how materials should be used or why their use can promote mathematical achievement.

The three studies will employ the methodology of a teaching experiment using fourth and fifth grade subjects.

Data will be qualitative in nature and will contain information on students' problem-solving ability as well as information on students' acquisition of rational numbers. The effects of the proposed instructional programs will be examined in the context of a theoretical model derived from psychology.

$198,600	SED 79-20591
Awarded: 09-13-79	NSF Program Manager:
Terminates: 02-28-82	Mary Budd Rowe
	Research in Science Education

Research Studies on the Scientific Literacy of the Attentive Public

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This research has examined the applicability of a stratified public opinion model of scientific literacy. The research project has sought 1) to develop an operational definition and to measure the current size, composition, and structure of the attentive public for organized science; 2) to construct a developmental pre-adult model; and 3) to assess the level of scientific literacy of the attentive public and to determine any science education and information needs.

During the first 20 months of activity, this project 1) has designed and pilot-tested a 16-page survey instrument, the "1978 National Public Affairs Study"; 2) has conducted a national survey of approximately 4,800 high school and college students; 3) has coded and edited over 2 million fields of data and has produced a consolidated codebook; and 4) has run several data analyses which have led to the presentation of eight papers at professional meetings.

During the current award the project will conduct 1) an extensive analysis of gender differences in the development of attentiveness to science; and 2) several analyses to elaborate a general theory of the development of attitudes toward low-salience topics.

$88,700
Awarded: 09-23-77
Terminates: 06-30-80

SED 77-18491
NSF Program Manager:
Raymond Hannapel
Research in Science Education

74

Facilitating Problem Solving in High School Chemistry

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Students who study chemistry appear to have a particularly difficult time solving certain kinds of problems. Analysis of items on the American Chemical Society/National Science Teachers Association chemistry achievement tests indicate that performance on problem-solving tasks is especially difficult. This study attempts to identify instructional treatments that will lead to improved problem solving in chemistry. Four distinct kinds of presentation will be prepared for each of four major chemical topics that seem especially difficult. High school chemistry students whose proportional reasoning, verbal, and visual aptitude have been measured, will be randomly assigned to instructional formats. Achievement will be measured by tests. Problem-solving processes of students with different aptitude patterns will be studied.

The investigation has both practical and theoretical implications. On the one hand, it can uncover which formats are particularly helpful for students with different aptitude profiles. On the other hand, it provides a test of the theoretical learning models that show how different memory structures can be used in rule applications which are relevant to problem solving.

$52,200
Awarded: 09-06-79
Terminates: 02-28-81

SED 79-20744
NSF Program Manager:
Mary Budd Rowe
Research in Science Education

Analysis and Synthesis of Mathematical Problem-Solving Processes of Early Adolescents

Gerald Kulm
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West Lafayette, Indiana 47907

The proposed project will produce a comprehensive analysis and synthesis of mathematical problems and the processes used to solve them by children in grades 6 to 9. Taped interview data will be collected from studies which have used the "think aloud" technique to study problem-solving behavior. The problems will be analyzed to identify common structures. The children's processes for solving the problems will be analyzed with a common process coding scheme that has been developed from previous research.

Data will be synthesized to produce characterizations of children's problem-solving behavior, hypotheses about the relationships between processes and tasks, suggestions for classroom teaching, and directions for future research. The problems, and tapes, and the analyses of them will be made available to other researchers through a national collection of research instruments for mathematical problem solving.

$117,700
Awarded: 08-30-79
Terminates: 11-30-81

SED 79-20596
NSF Program Manager:
Douglas B. McLeod
Research in Science Education

Calculator Use and Problem-Solving Strategies of Early Adolescents

Grayson H. Wheatley
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West Lafayette, Indiana 47907

The purpose of this study is to compare the problem-solving performance and strategies of sixth grade pupils with and without calculator experience. The subjects will be from 18 classes of sixth grade pupils randomly assigned to one of three groups: 1) pupils experienced in problem solving with calculators, 2) pupils experienced in problem solving without calculators, and 3) a control group. All classes will be pre- and post-tested. A sample of 90 randomly selected subjects will be interviewed as they solve mathematics problems. The sample will be partitioned into three ability groups to study the treatment by ability interactions. Analyses will be performed on problem-solving scores, and on the number, range, and type of strategies used. Six case studies will also be conducted to provide a more detailed description of how students use calculators to solve problems.

$97,700
Awarded: 08-29-79
Terminates: 01-31-82

SED 79-19614
NSF Program Manager:
Douglas B. McLeod
Research in Science Education

Determining the Impact of a National Educational Computing Conference

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This award will provide support for the evaluation of a national conference on educational computing.

The National Educational Computing Conference (NECC) was scheduled for the summer of 1979 and had the following objectives: 1) presentation in the forum of major work regarding computers in education in the United States; 2) interaction among individuals involved in the various aspects of computer uses in precollege and college education; 3) the production of a proceedings documenting the status of computers in education in the United States; and 4) development of better liaison and coordination among the education groups of the member societies of the American Federation of Information Processing Societies (AFIPS) and with other groups involved with computer uses in education, such as the American Society of Electrical Engineering and the Mathematical Association of America.

The award provides support for an umbrella steering committee that will oversee an evaluation of the effect of NECC upon the attendees, relative to the use of computers. The evaluation results will be used to plan for a second conference, tentatively scheduled for summer 1980.

$26,860	SED 78-25102
Awarded: 06-22-79	NSF Program Manager:
Terminates: 12-31-80	Raymond Hannapel
	Research in Science Education

The Representation and Use of Complex Knowledge: Knowing and Reasoning in Physics

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This project is concerned with physical events. Three populations of college students will be studied: 1) untutored students, who have had no formal instruction in physics; 2) beginners, who have completed one college-level physics course; and 3) experts, who are advanced undergraduate physics majors or graduate students in physics. A major concern of the project will be to characterize differences in knowledge and reasoning among people with different degrees of expertise in physics.

Several series of experiments will be conducted. In one series, subjects will be presented with descriptions of situations (e.g., "a cannon ball falls from the mast of a moving ship") and asked to predict and explain the physical events that will occur (e.g., "where will the ball land, and why?"). Additional experiments will employ memory procedures, reaction time methods, and other techniques.

The results should provide a rich data base which will support the development of models of knowledge representation. In addition, results concerning the differences in knowledge and reasoning among people with different degrees of expertise could provide the basis for the formulation of questions about the "developmental" course of the acquisition of complex knowledge that are of concern not only to cognitive psychologists, but also to educators.

$139,270
Awarded: 08-15-79
Terminates: 05-31-82

SED 79-12741
NSF Program Manager:
Erik D. McWilliams
Research in Science Education

Funding and administration for this project are provided jointly by the National Institute of Education and by NSF under a program of research on cognitive processes and the structure of knowledge in science and mathematics.

Research on Gifted Children in Accelerated Teaching Programs in Physics, Chemistry, and Mathematics

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During the 1972-74 Study of Mathematically Precocious Youth (SMPY) at the Johns Hopkins University, three large searches were conducted for talented students among seventh and eighth graders in Maryland, and then effective ways were devised to improve the pace and quality of the talented youths' learning of mathematics. Those students have been followed into college via systematic questionnaire surveys. An analysis will be made of the effectiveness of accelerated programs, and a symposium will be held to review what has been learned from those three talent-search cohorts so that principles, practices, and programs devised can be validated and used across the country. Also, Advanced Placement Program college freshman-level physics, chemistry, and calculus courses will be conducted to determine if highly qualified youths can be prepared for the more advanced levels of college science and mathematics through accelerated programs. From this effort should come new models for teaching science to precocious youths.

$106,704
Awarded: 08-29-79
Terminates: 08-31-81

SED 79-20868
NSF Program Manager:
Andrew R. Molnar
Research in Science Education

Development and Facilitation of Cognitive Representation in Estimation Problems

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The proposed research will investigate the development of children's solutions to problems requiring estimation, and the nature of cognitive representations that guide their solutions.

A tentative process model distinguishes at least two basic types of estimation processes: benchmark (comparison with something of known size), and decomposition/recomposition (breaking the object into pieces, each of which can be estimated), which may be hierarchically related, temporally sequential, and developmentally ordered. Thus, it is thought that benchmark estimation develops earlier in children and will be invoked earlier in the problem-solving sequence.

The study proposes the development of representations of estimation problems by examining the problem solutions of children and young adults through 1) normative data on the development of solutions to specified types of estimation problems; 2) analyses of selected children and adult "experts"; and 3) experiments to assess effects of model-based instructional manipulations. Children's performance will be studied both developmentally and over shorter periods of time.

$113,123	SED 79-12743
Awarded: 08-15-79	NSF Program Manager:
Terminates: 02-28-82	Erik D. McWilliams
	Research in Science Education

Funding and administration for this project are provided jointly by the National Institute of Education and by NSF under a program of research on cognitive processes and the structure of knowledge in science and mathematics.

Conceptual Change in Children and in Adult Scientists

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77 Massachusetts Avenue
Cambridge, Massachusetts 02139

Investigators from the fields of psychology and the philosophy of science will investigate the parallels between conceptual development during childhood and conceptual change in the history of science. Contemporary psychologists such as E. Gibson, J. Piaget, and H. Werner, consider that there are no contexts where the distinctions among what will become the differentiated concepts, are expressed. The investigators believe this assumption to be false, namely, that concepts which appear not to be differentiated at all by a subject will in fact, become readily differentiable under the proper conditions. Furthermore, the investigators argue that the development of conceptual differentiation by individuals is closely parallel to the differentiation of theoretical concepts in the history of science. They will analyze the development of the child's concept of weight, volume, and density in comparison with the differentiation of these concepts in the history of science, and will study the historical development of the concepts of heat and temperature, in order to pursue the comparison further.

$134,887
Awarded: 08-15-79
Terminates: 02-28-82

SED 79-13278
NSF Program Manager:
Erik D. McWilliams
Research in Science Education

Funding and administration for this project are provided jointly by the National Institute of Education and by NSF under a program of research on cognitive processes and the structure of knowledge in science and mathematics.

The Ecology of Failure in Ninth Grade General Mathematics: An Ethnographic, Experimental, and Psychometric Inquiry

Perry E. Lanier
Michigan State University
East Lansing, Michigan 48824

This project will identify and describe the relationship of the teaching/learning environments of a general mathematics class and an algebra class to the students' mathematical development and achievement in such classes.

Using the experiences of both students and teachers in mathematically disadvantaged classes of ninth graders, the project will identify 1) the mathematics abilities of potentially failing students; 2) differences in the attitudes and understanding of students in general mathematics and students in algebra I; 3) differences in teaching styles and attitude in those two classes; and 4) improved approaches for teaching mathematically disadvantaged students.

Forty ninth grade students, 20 in each of two schools, will be studied, with 10 in algebra class and 10 in general mathematics. In each school the two classes will be taught by the same teacher. Students will be selected so as to have nearly equivalent groups with respect to mathematics ability. One observer will monitor the students in each group, and another will monitor the teachers.

$191,600
Awarded: 08-14-79
Terminates: 02-28-82

SED 79-20593
NSF Program Manager:
Douglas B. McLeod
Research in Science Education

Synthesis of Research on Individualized Science Teaching in Secondary Schools

James A. Kulik
University of Michigan
Center for Research on Learning and Teaching
109 E. Madison Street
Ann Arbor, Michigan 48109

The project will apply statistical or "meta-analytic" techniques to the results of hundreds of studies of individualized secondary school science teaching, in order to reach general conclusions about the effects of individualization. Project staff members will first search the educational literature for comparisons of conventional and individualized teaching, where individualization is achieved through homogeneous grouping of students, special tutoring arrangements, or acceleration of talented students, or through the use of programmed materials, self-paced modules, or computer-assisted instruction. After characterizing in quantitative terms the outcomes and characteristics of the studies of individualization, project staff will use statistical techniques to describe overall effects of these methods and to relate study features and study outcomes. The project is expected to contribute to knowledge about individualized instruction and to the development of methods for synthesizing results of educational research in science education.

$148,562
Awarded: 08-23-79
Terminates: 09-30-81

SED 79-20742
NSF Program Manager:
Andrew R. Molnar
Research in Science Education

Computer Awareness and Literacy of Adolescent and Early Adolescent Students: An Empirical Assessment

Daniel L. Klassen
Minnesota Educational Computing Consortium
2520 Broadway Drive
St. Paul, Minnesota 55113

Widespread understanding of computers and their uses is crucial to the survival of a computer-dependent society as well as to the effective functioning of the individual. Efforts to introduce computer literacy instructional programs in schools are expanding rapidly; however, information concerning the levels and correlates of students' conceptions and understanding of computers is lacking.

The proposed research involves the analysis of data describing computer literacy of a statewide sample of all 11th grade students in Minnesota. The research also involves a survey of computer literacy among early adolescent students (eighth grade students). Analysis of the data will yield an exploration of causal factors underlying computer literacy. Contrasts between early and late adolescent students will be made.

$82,894
Awarded: 09-04-79
Terminates: 02-28-81

SED 79-20087
NSF Program Manager:
Andrew R. Molnar
Research in Science Education

Scientific Reasoning: Cognitive Processes in Using and Extending Problem-Solving Skills

Paul E. Johnson
University of Minnesota
Minneapolis, Minnesota 55455

Scientific reasoning by specialists and non-specialists can be improved only if we understand better the nature of the skills that comprises it. The proposed research focuses on how experts and novices in a scientific field differ with regard to 1) their strategy and tactics in solving challenging scientific problems in that field; and 2) the means they use to extend their problem-solving skills to unfamiliar areas.

Two types of research will be conducted: 1) studies that examine problem-solving work through written and oral protocols, and 2) studies that examine the relative degree of expertise in problem-solving, by restricting the available resources.

Three levels of expertise will be investigated: that of college undergraduates, of graduate students, and of professors. Expected results include: 1) identification of bases for successful problem solving in science (at novice as well as expert levels), and 2) elucidation of possible strategies for acquiring problem-solving skills in science, including continuing professional education.

$128,588
Awarded: 08-15-79
Terminates: 02-28-82

SED 79-13036
NSF Program Manager:
Erik D. McWilliams
Research in Science Education

Funding and administration for this project are provided jointly by the National Institute of Education and by NSF, under a program of research on cognitive processes and the structure of knowledge in science and mathematics.

Inventory of Computing Activities and Related Degree Programs in U. S. Higher Education-Dissemination

John W. Hamblen
University of Missouri
325 Mathematics - Computer Science Building
Rolla, Missouri 65401

A data base was created from the "Fourth Inventory of Computers in Higher Education." The data base includes information about 1) institutions (comparative and longitudinal data on computer expenditures, staff usage); 2) instruction (use of computers in various disciplines); 3) research (the availability of computers for research and use in research); 4) use of computers in administration; 5) equipment (system costs, languages, and utilization); 6) networks and special resources; 7) manpower; 8) finance, and 9) degree programs (graduate, four-year, and two-year).

This project will allow the principal investigator to respond to requests for specialized studies in a timely manner. The data base will be used to prepare specialized analyses for state boards of higher education, and interpretive, comparative, and longitudinal studies. A summary of the types of categories of data in the data base is being sent to each institution that participated in the survey, and the summary has recently been published in EDUCOM, Bulletin of Interuniversity Council.

$30,000
Awarded: 08-13-79
Terminates: 02-28-82

SED 79-18504
NSF Program Manager:
Andrew R. Molnar
Research in Science Education

Effects of Processing Style on Problem Solving in Mathematics

David E. Weldon
Washington University
St. Louis, Missouri 63130

Recent research in mathematics learning has indicated that spatial ability is essential to high-level mathematics achievement. Recent studies in cerebral hemisphere dominance suggest that the right hemisphere is specialized for temporal and spatial pattern analysis while the left hemisphere is specialized for verbal/symbolic functions. Finally, data from our research suggest that individuals have strong preferences for using predominantly visuospatial or verbal/symbolic processing and that these preferences, as indexed by preferred gaze direction during problem solving, affect problem-solving success.

Four studies are proposed which examine these phenomena within the domain of calculus. These studies investigate perception of problem type, problem-solving success, and the problem-solving process as a function of preferred eye gaze direction. It is expected that these investigations will shed light on individual differences in problem-solving success and strategies and that the findings will generalize to other domains of mathematics as well.

$61,536
Awarded: 08-15-79
Terminates: 02-28-81

SED 79-12786
NSF Program Manager:
Erik D. McWilliams
Research in Science Education

Funding and administration for this project are provided jointly by the National Institute of Education and by NSF, under a program of research on cognitive processes and the structure of knowledge in science and mathematics.

An Investigation of the Structure and Dynamics of Classroom Communication of Science

Jay L. Lemke
Brooklyn College of the City University of New York
Bedford Avenue and Avenue H
Brooklyn, New York 11210

This project investigates the way teachers communicate about science to their students. It asks to what extent conventional patterns of communication about science are meaningful for middle and secondary school students. Normal science communication has some characteristics which are typically absent in everyday social discourse: e.g., least falsifiable modes of assertion; use of specialized language and symbols; most logical ordering of evidence and inferences; etc. This project will ask to what extent these factors are a block to achieving science literacy and how the communication of science in classrooms may be facilitated.

Field notes of observers and audio-tapes of science classes taught by experienced and inexperienced teachers will be analyzed by qualitative-comparative techniques based on the methods of discourse linguistics, ethnography, and human communication theory.

A portion of the data will be used to generate hypotheses and to derive a tentative model of science communication. Another part of the data will be used to validate the model. This investigation has implications for both the theory and practice of science education.

$70,132
Awarded: 08-14-79
Terminates: 04-30-82

SED 79-18961
NSF Program Manager:
Mary Budd Rowe
Research in Science Education

Strategies and Structures in Understanding Geometry

Harry Beilin
City University of New York
Graduate School & University Center
33 West 42nd Street
New York, New York 10036

This research project is designed to determine whether 1) strategies (more specifically, algorithms and heuristics) are generated spontaneously by children in the solution of geometry problems before they acquire solution strategies through school instruction; 2) strategies spontaneously generated can provide a model for the construction of effective instructional procedures that will be superior to methods derived from other sources; and 3) strategies spontaneously produced for the solution of particular problems can be generalized to related problems if and only if related facts, operations, or structures exist in the child's repertoire.

These relations will be tested by observing the problem-solving behavior of urban children ranging in age from four years to 11 years as they solve elementary geometry problems of the kind they will later encounter in school classes. The goal of this research is to contribute to an understanding of the way in which children who have certain cognitive abilities approach the solution of mathematics problems to provide a basis for improving instructional procedures in mathematics, particularly in geometry.

$108,440	SED 79-12809
Awarded: 08-15-79	NSF Program Manager:
Terminates: 02-28-82	Erik D. McWilliams
	Research in Science Education

Funding and administration for this project are provided jointly by the National Institute of Education and by NSF, under a program of research on cognitive processes and the structure of knowledge in science and mathematics.

Expert and Novice Mathematical Problem Solving

Alan H. Schoenfeld
Hamilton College
Clinton, New York 13323

The project consists of three interrelated studies on the nature of expert and novice problem-solving processes in college level mathematics. The purpose of the first study is to refine a general model of expert mathematical problem solving. The model will provide a baseline of data for the second study, and will serve as the foundation for a course in problem solving, the effects of which are investigated in the third study.

Study 2 seeks to characterize the nature of novice problem solving. The subjects are lower division students at a liberal arts college. Efforts will focus on both local and global descriptions of novice problem solving: for example, do novices recognize certain "cues" which experts do; and to what degree is the nature of novice planning similar to or different from that of experts?

Study 3 examines the effects of a month-long intensive problem-solving course (based explicitly on the model) on the novices' performance. Questions to be considered include the following: will students think to apply strategies that they had not applied prior to the instruction? If so, to what effect? Will there be noticeable differences in the global aspects of their problem solving, such as in planning?

$94,900	SED 79-19049
Awarded: 08-07-79	NSF Program Manager:
Terminates: 03-31-82	Douglas B. McLeod
	Research in Science Education

The Relationship Between Continuing Education and Career Development of Scientists and Engineers

Harold G. Kaufman
Polytechnic Institute of New York
Divison of Management
#333 Jay Street
Brooklyn, New York 11201

The broad objective of this research will be to determine the effects of continuing education in science and engineering on career development. The research involves a longitudinal study that will use existing information on careers, education, and training obtained from the National Science Foundation's National Sample of Scientists and Engineers between 1972 and 1978. The longitudinal design, together with appropriate statistical techniques, will be used to analyze a large representative sample of U. S. scientists and engineers. The expected significance of the research lies in its potential to increase our understanding of how to attain improvements in the career development and productivity of this Nation's scientific and engineering human resources through changes in corporate, educational, and government policies and practices pertaining to continuing education.

$64,420	SED 79-20143
Awarded: 08-13-79	NSF Program Manager:
Terminates: 02-28-81	Andrew R. Molnar
	Research in Science Education

Elementary School Science Processes Program: Meta-Analysis of Evaluation Studies

Theodore A. Bredderman
State University of New York
Albany, New York 12222

The purpose of this investigation is to synthesize what was learned from 80 evaluation studies of three NSF-funded elementary science programs that would be important to consider in future science curriculum development efforts. The synthesis provides a means for making inferences from studies of the three major programs. These investigations were conducted under different conditions and with diverse kinds of students. The method of the synthesis, secondary analysis, helps to make clear patterns of relationships that are detectable in the collection of studies and not necessarily detectable from any one study. Pilot work by the investigator using the secondary analysis technique suggests, for example, that the programs that use manipulative materials may have been especially beneficial for disadvantaged children. This research is expected to have implications for science educational policy- and decision-makers, curriculum developers, and researchers.

$26,720
Awarded: 08-06-79
Terminates: 05-31-81

SED 79-18717
NSF Program Manager:
Mary Budd Rowe
Research in Science Education

School, Family, and Individual Influences on Commitment to and Learning of Science Among Adolescent Students

Ronald D. Simpson
North Carolina State University
326 Poe Hall
Raleigh, North Carolina 27650

What are factors that relate to the development of science literacy in young people? This study investigates relationships among academic, family, attitude, aptitude, and curricular factors to determine how commitment to science develops. Commitment to science does not mean just intent to major in science but rather the development of knowledge, attitudes, and ways of thinking about science as an enterprise. The procedures employed include tests, attitude surveys, observations of instruction, analysis of curriculum, and interviews. Data will be incorporated into an analytic model which then will be made available for wider use in order to test its predictive capability. It is expected that such a model would be useful for science education planners, school administrators, and parents.

$121,230	SED 79-19784
Awarded: 08-29-79	NSF Program Manager:
Terminates: 02-28-82	Mary Budd Rowe
	Research in Science Education

Assessing Children's Intellectual Growth in Geometry

William F. Burger
Oregon State University
Corvallis, Oregon 97331

This project is an investigation of children's intellectual growth in geometry from grades 1 through 11.

The five levels of growth in geometry as proposed by P. M. and Nina van Hiele will be studied. Using individual interviews, the researchers will develop mathematical problems and interview techniques for assessing children's development in geometry. Interviews will be analyzed qualitatively to describe students' reasoning processes that correspond to van Hiele's five levels and quantitatively to compute the extent of agreement among the researchers in identifying growth to particular levels. The study can serve as a basis for designing instructional materials and in preparing students for the study of high school geometry.

$170,747
Awarded: 09-21-79
Terminates: 02-28-82

SED 79-20568
NSF Program Manager:
Douglas B. McLeod
Research in Science Education

Cognitive Processes and Knowledge Structures Used in Solving Physics Problems

Gordon S. Novak, Jr.
University of Texas
Austin, Texas 78712

The proposed research will investigate the cognitive processes and knowledge structures required to solve physics problems by means of a working computer program which can solve problems stated in English. Expressing the rules for analysis of a problem formally in a computer program will allow them to be tested on actual problems to verify the competence of the rule set. The rules used by the program will be compared to rules inferred from protocols of expert and novice problem solvers and to the form in which physical laws are presented in selected textbooks.

Formal explication of the procedures for analysis of problems will make it possible to teach these procedures explicitly. Moreover, the computer program could form the basis of an intelligent computer-assisted instruction program which understands the process of problem solving in physics.

$100,000
Awarded: 08-15-79
Terminates: 02-28-82

SED 79-12803
NSF Program Manager:
Erik D. McWilliams
Research in Science Education

Funding and administration for this project are provided jointly by the National Institute of Education and by NSF, under a program of research on cognitive processes and the structure of knowledge in science and mathematics.

Conceptual Understanding of Physics Students and Identification of Influencing Factors

James A. Minstrell
Mercer Island School District #400
4160 - 86th Avenue S. E.
Mercer Island, Washington 98040

This project will study the relative importance of general brightness, ability to reason logically, and representation skills, to students' understanding of high school physics. It is hypothesized that each of these factors influences conceptual understanding, particularly the correction of misconceptions, in physics. Such misconceptions have proved to be resistant to change even after considerable formal instruction, and the proposed research may identify some of the factors which impede such change.

Research methods used in this investigation will be largely descriptive. Pre-tests, post-tests, and in-course examinations, along with observations of classroom behavior during experiments, tape recordings of class discussions, and out-of-class semi-structured clinical interviews will provide evidence of the factors affecting changes in conceptual understanding. Simple attempts to control, correlate, and test for differences will be used to revise or justify the hypothesized relationships between conceptual understanding and general brightness, logical operations, and representational skills. Rigorous tests of the hypothesized relationships will be left for future research efforts.

$24,350	SED 79-12824
Awarded: 08-15-79	NSF Program Manager:
Terminates: 02-28-81	Erik D. McWilliams
	Research in Science Education

Funding and administration for this project are provided jointly by the National Institute of Education and by NSF, under a program of research on cognitive processes and the structure of knowledge in science and mathematics.

Computing and Higher Education: Issues and Opportunities

Robert G. Gillespie
University of Washington
Seattle, Washington 98105

This study seeks to provide a clear statement of the broad issues of computing and higher education. It will develop the issues through a review of past and recent statements, a broad national panel discussion, and review by principal professional and educational groups.

The penetration of the computer in universities is a visible and rapidly occurring process. Twenty-five years ago, only a handful of universities had computers; today, over 90% of universities and colleges either have or use computers. This penetration was aided in the 1960s by support from the National Science Foundation for purchase of computers and the regional network programs. These programs were spurred by two important studies by the National Academy of Science/National Research Council (Rosser), and the President's Science Advisory Committee (Pierce) in the mid-1960s.

Studies sponsored by the Carnegie Commission and others have focused on the instructional uses of computing. Recent hearings by the House Committee on Science and Technology have focused on *Computing and the Learning Society*. However, the broad issues associated with computing and higher education have not been clearly described since the Pierce and Rosser studies. The impact of technology, the demands for improved quality, and the conflicts of limited budget affect universities' approach to computing.

$95,253
Awarded: 02-06-79
Terminates: 11-30-80

SED 78-23790
NSF Program Manager:
Andrew R. Molnar
Research in Science Education

Interpretive Reports of the Second National Assessment in Mathematics

Thomas Carpenter
(National Council of Teachers of Mathematics)
University of Wisconsin
Dept. of Curriculum and Instruction
Madison, Wisconsin 53706

This project will examine the data and technical reports of the NAEP Second Mathematics Assessment and will prepare interpretive manuscripts for journal and popular publications.

The various audiences of mathematics education—classroom teachers, teacher educators, researchers, administrators, general public—will be addressed in separate manuscripts. Types of manuscripts will include general summaries and overviews, analyses of particular subgroups' performance (e.g., women or minorities), topic specific notes emphasizing implications for teaching, special assessment topics (e.g. attitudes or handheld calculators), research papers, and papers bringing assessment information to bear on specific issues of national interest.

A major purpose of the project will be the preparation of an assessment interpretation for the NCTM Committee on Mathematics Curriculum for the 1980s and for presentations at the 1980 NCTM Annual Meeting.

$86,800	SED 79-20086
Awarded: 08-23-79	NSF Program Manager:
Terminates: 01-31-82	Raymond Hannapel
	Research in Science Education

Research on Relationship of Spatial Visualization and Confidence in Male/Female Mathematics Achievement in Grades 6-8, Phase 2

Elizabeth Fennema
University of Wisconsin
Madison, Wisconsin 53706

Women are usually underrepresented in careers related to mathematics. Factors that contribute to this underrepresentation include individual differences in spatial visualization and lack feelings of confidence or feelings of anxiety toward mathematics. This project will investigate those factors, their development and stability, and their effect upon mathematical problem solving.

This project is part of a longitudinal study of three years' duration. The project is proceeding on schedule. Sixth-grade students who differ in spatial ability or confidence have been identified and tested, interview procedures have been developed and refined, and a substantial amount of data has been gathered. The data have been organized and the analysis has begun. The funding in this continuing grant will provide for the remaining data collection and analyses.

Assessing and interviewing these students over a three-year period will provide extensive information about the relationship of spatial visualization and confidence about mathematics to mathematical problem solving and to the participation of women in mathematically-oriented careers. Both sexes are being studied to determine what factors are related to decisions by females and males to continue their study of mathematics.

$230,090	SED 78-17330
Awarded: 09-28-78	NSF Program Manager:
Terminates: 08-31-82	Douglas B. McLeod
	Research in Science Education

SECTION II

Projects Funded
Fiscal Year 1978 and Earlier

On the following pages are titles of projects which appeared with summary descriptions in NSF publication SE 79-80.

This listing is for use with the Key Word/Phrase Index. The summary description of the projects may be obtained by requesting publication SE 79-80 from Forms and Publications, National Science Foundation, Washington, D.C. 20550.

To assist in locating particular projects, principal investigators are listed, by State and Institution, and alphabetically by name, on pages 136, 142 and 152, respectively.

Titles and Principal Investigators of Projects Funded Fiscal Year 1978 and Earlier Years*

DEVELOPMENT IN SCIENCE EDUCATION

Issue-Oriented Instructional Modules for Introductory College Physics Classes
    Dr. Arnold Strassenburg — A
    American Association of Physics Teachers
    State University of New York
    Stony Brook, New York 11794

Undergraduate Education Improvement in Political Science: Innovation in Instructional Materials
    Dr. Sheilah K. Mann — B
    American Political Science Association
    Washington, DC 20036

Outlines in Microbiology for Community and Junior Colleges
    Dr. Helen L. Bishop — C
    American Society for Microbiology
    Washington, DC 20006

Teaching Materials in Microbiology
    Dr. Helen L. Bishop — D
    American Society for Microbiology
    Washington, DC 20006

Development of a Mobile Spectroscopy Laboratory (Completed)
    T. D. Roberts — E
    University of Arkansas
    Fayetteville, Arkansas

Teaching and Learning in Graduate Geography (Completed)
    Dr. William D. Pattison — F
    Association of American Geographers
    Washington, DC 20009

*A summary description of each project is contained in publication SE 79-80 that may be obtained by request to: Forms & Publications, National Science Foundation, Washington, DC 20550.

Study on Courses in Computer Literacy and the Impact of Computers on Society (Completed)
Dr. Richard H. Austing A
Association for Computing Machinery, Inc.
1133 Avenue of the Americas
New York, New York 10036

Dissemination of Instructional Materials (History-of-Physics Laboratory) (Completed)
Dr. Samuel Devons B
Barnard College
New York, New York 10027

Development of Instructional Films in Ethology—"Behavior of the Ring Dove"
Dr. Rae Silver C
Barnard College
New York, New York 10027

Human Sciences Program (HSP): A Three-Year Integrated Human Sciences Curriculum for Middle Schools
Dr. William V. Mayer D
Biological Sciences Curriculum
Study Company
Box 930
Boulder, Colorado 80302

Dissemination of Logo-Based Educational Research (Completed)
Dr. Wallace Feurzeig E
Bolt, Beranek & Newman, Inc.
Cambridge, Massachusetts 02101

Activity-Based Education Programs for Small- and Medium-Size Planetariums
Dr. Robert Karplus F
Lawrence Hall of Science
University of California/Berkeley
Berkeley, California 94720

Development of Pilot Astronomy Activities for Informal Learning
Dr. Robert Karplus A
University of California/Berkeley
Berkeley, California 94720

Outdoor Biology Instructional Strategies (OBIS) (Completed)
Dr. Watson M. Laetsch B
University of California/Berkeley
Berkeley, California 94720

An Urban Extension Service Model (Completed)
Dr. Perry Shapiro C
University of California/Santa Barbara
Santa Barbara, California 93106

Interdisciplinary Master's Programs in Building Studies (Completed)
Dr. Volker H. Hartkopf D
Carnegie-Mellon University
Pittsburgh, Pennsylvania 15213

Secondary Course in Applications of Mathematics to Science
Dr. Madeline P. Goodstein E
Central Connecticut State College
1615 Stanley Street
New Britain, Connecticut 06050

Survey of Recent East European Literature in School and College Mathematics
Dr. Izaak Wirszup F
The University of Chicago
Department of Mathematics
Chicago, Illinois 60637

Career-Oriented Degree Programs in the Mathematical Sciences with Emphasis on Practical Experience
Dr. Jerome Spanier A
Claremont University Center
Claremont, California 91711

An Alternative in Higher Education in the Mathematical Sciences (Completed)
Dr. Clayton V. Aucoin B
Clemson University
Clemson, South Carolina 29631

Learner-Controlled Instructional Strategies: An Empirical Investigation (Completed)
Dr. M. David Merrill C
Courseware, Inc.
9820 Willow Creek Road
San Diego, California 92131

XPRT - Experimental Partnership for the Reorientation of Teaching (Completed)
Dr. Richard E. Woodring D
Drexel University
Center for Teaching Innovation
Philadelphia, Pennsylvania 19104

A Computer Conferencing System for Peer Evaluation and Commentary on Essay Tests
Dr. Jerome H. Woolpy E
Earlham College
Richmond, Indiana 47374

Instructional Modules in Applied Mathematics in Higher Education (UMAP)
Dr. Ross L. Finney F
Education Development Center, Inc.
Newton, Massachusetts 02160

Administrative Activities Related to NSF-Supported Curriculum Materials
Dr. Jerry D. Murphy A
Education Development Center
Newton, Massachusetts 02101

Quantitative Understanding to Enhance Social Science Teaching
Dr. Irving Morrissett B
Educational Resources Center, Inc.
Boulder, Colorado 80302

Individualized Science Instructional System
Dr. Ernest Burkman C
Florida State University
Tallahassee, Florida 32306

Development of an Interactive Conversational Computer Model for Linear Programming (Completed)
Dr. John J. Jarvis D
Georgia Institute of Technology
Atlanta, Georgia 30332

Psychoacoustic Demonstration Tapes (Completed)
Dr. David M. Green E
Harvard University
Cambridge, Massachusetts 02138

Curriculum Analysis, Student Interrogation and Information System
Dr. Ernest J. Henley F
College of Engineering
University of Houston
Houston, Texas 77004

The Development of Modules for the Undergraduate Chemical Engineering Curriculum and Continuing Education (CACHE)
Dr. Ernest J. Henley A
College of Engineering
University of Houston
Houston, Texas 77004

Family-Involving Science Education for Elementary School Children
Dr. Michael E. Browne B
University of Idaho
Moscow, Idaho 83843

Demo-Graphics: Teaching Population Dynamics in a Multidisciplinary Framework with Interactive Visual Graphics (Completed)
Dr. Paul Handler C
University of Illinois
Urbana, Illinois 61801

Conduit: Consortium for the Dissemination of Computer-Based Curricular Materials (Completed)
Dr. James W. Johnson D
University of Iowa
Iowa City, Iowa 52240

Computer-Assisted Data Analysis
Dr. Melvin R. Novick E
University of Iowa
Iowa City, Iowa 52242

Developing Science Curriculum Units Using the Teams-Games-Tournaments Instructional Process
Dr. John H. Hollifield F
Center for Social Org. of Schools
The Johns Hopkins University
Charles & 34th Streets
Baltimore, Maryland 21218

Development of a General Engineering Technician Curriculum (Completed)
Dr. Donald R. Mowery A
Junior College District of St. Louis
St. Louis, Missouri 63110

Educational Modules Development for the Nuclear Fuel Cycle (Completed)
Dr. N. Dean Eckoff B
Kansas State University
Manhattan, Kansas 66506

Educational Computer-Based Models for Socio-Economic-Technological Situations (E-COMSETS)
Dr. William E. Schiesser C
Lehigh University
Bethlehem, Pennsylvania 18105

Conversion of Text to Speech for Computer-Aided Instruction (Completed)
Dr. Jonathan Allen D
Massachusetts Institute of Technology
Cambridge, Massachusetts 02139

A Model Program for Continuing Education in Chemical Engineering (Completed)
Dr. Karen C. Cohen E
Massachusetts Institute of Technology
Cambridge, Massachusetts 02139

Instruction Materials and Delivery Systems for an Undergraduate Curriculum in Pest Management for Plant Protection (Completed)
Dr. D. L. Armstrong F
Dr. Fred H. Tschirley
Michigan State University
East Lansing, Michigan 48823

Problem-Oriented Physics Instruction (Completed)
Dr. Peter Signell A
Michigan State University
East Lansing, Michigan 48824

Curricular Materials in Computer-Aided Ship Design (Completed)
Dr. John Woodward B
The University of Michigan
Deparment of Naval Architecture
Ann Arbor, Michigan 48109

High School Minicourse on Chronobiology
Dr. Franz Halberg C
University of Minnesota
Minneapolis, Minnesota 55455

Development of Resource Material for Instruction in Use of Underground Space (Completed)
Dr. Truman Stauffer D
Department of Geosciences
University of Missouri
Kansas City, Missouri 64110

Inventory of Computing Activities and Related Degree Programs in U.S. Higher Education
Dr. John W. Hamblen E
University of Missouri
Rolla, Missouri 65401

Self-Paced Tutorial Courses for Mineral Science-Metallurgy Departments
Dr. L. G. Twidwell F
Montana College of Mineral
Science & Technology
Butte, Montana 59701

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Diagnostic and Instructional Services for Undergraduate Students of Statistics
Dr. Jerry A. Warren A
University of New Hampshire
Durham, New Hampshire 03824

Development of Teaching Materials for Computer Programming
Dr. David L. Parnas B
University of North Carolina
Chapel Hill, North Carolina 27514

Development and Trial of an Integrated Undergraduate Science Major Program (Completed)
Dr. Mark Pinsky C
Northwestern University
Evanston, Illinois 60201

Development of a Coherent Series of Participatory Exhibits for the Palace of Arts and Science Foundation Exploratorium in San Francisco
Dr. Frank Oppenheimer D
Palace of Arts & Science Foundation
San Francisco, California 94123

Development of Modular Courses in Science, Technology and Society for University Freshmen and Sophomores
Dr. Philip M. Becker E
Pennsylvania State University
University Park, Pennsylvania 16802

Educational Modules for Materials Science and Engineering (EMMSE)
Dr. Rustum Roy F
Pennsylvania State University
University Park, Pennsylvania 16802

Guidebook for the Implementation and the Use of Computer Generated Graphic Displays in the Undergraduate Mathematics Curriculum Dr. Gerald J. Porter University of Pennsylvania Philadelphia, Pennsylvania 19104	A
Development of Instructional Modules on the Environment (Completed) Dr. John J. Holleman Peralta Community College District Oakland, California 94610	B
Development of Curriculum and Instructional Material in Applied Sociology Dr. Burkart Holzner University of Pittsburgh Pittsburgh, Pennsylvania 15260	C
Development of a Cooperative Graduate Program in Engineering and Public Administration (Completed) Dr. J. I. Weindling Polytechnic Institute of New York Brooklyn, New York 11201	D
Development of Laboratory and Lecture Materials for Oceanography Teaching Dr. Harvey M. Sachs Princeton University Princeton, New Jersey 08540	E
Development and Distribution of Print Modules for Manufacturing Productivity Education Dr. Joseph El Gomayel Purdue University West Lafayette, Indiana 47907	F

Master of Science Degree in Applied Mathematics
Dr. Richard C. DiPrima A
Dr. William E. Boyce
Rensselaer Polytechnic Institute
Troy, New York 12181

The Preparation of Supplemental Instructional Units Based on Current Crustal Research for Use in Grades 8-10
Dr. Edward C. Stoever, Jr. B
Southeast Missouri State University
Cape Girardeau, Missouri 63701

University Level, Computer-Assisted Instruction (CAI) and Computer-Generated Speech in Mathematics
Dr. Patrick Suppes C
Stanford University
Stanford, California 94305

Development of Selected Undergraduate Course Materials in Applied Mathematical Modeling
Dr. Edward Beltrami D
State University of New York
Stony Brook, New York 11794

Modular Materials on Socio-Technological Problems and Issues
Dr. Thomas T. Liao E
State University of New York
Stony Brook, New York 11794

Computer-Oriented Teaching Modules in Geochemistry (Completed)
Dr. Philip C. Goodell F
University of Texas
El Paso, Texas 79968

Service-Oriented Options in Mathematics (Completed)
Dr. Donald Bushaw A
Washington State University
Pullman, Washington 99163

Physical Processes in Terrestrial and Aquatic Ecosystems (Completed)
Dr. Douglas G. Chapman B
University of Washington
Seattle, Washington 98195

Graphic Techniques for Teaching Statistical Concepts and Procedures (Completed)
Dr. Marshall J. Graney C
Wichita State University
Wichita, Kansas 67208

Sociotechnical Systems Design Program
Dr. Gerald Nadler D
University of Wisconsin
Madison, Wisconsin 53706

The Worcester Polytechnical Institute Plan (Completed)
Dr. William R. Grogan E
Worcester Polytechnic Institute
Worcester, Massachusetts 01609

CONTINUING EDUCATION FOR SCIENTISTS AND ENGINEERS

Multimedia User-Controlled Modes of Continuing Education in Chemistry

Dr. Moses Passer **A**
American Chemical Society
Washington, D.C. 20036

First World Conference on Continuing Engineering Education (Completed)

Professor John P. Klus **B**
American Society for Engineering
Education/Continuing Education
Studies Division
432 N. Lake Street
Madison, Wisconsin 53706

Continuing Education for Employed Clinical Engineers

Dr. Cesar A. Caceres **C**
AAMI Foundation
Arlington, Virginia 22209

University Consortium to Increase National Effectiveness of Continuing Education for Engineers

Dr. Charles R. Vail **D**
Association for Media-Based
Continuing Education for Engineers, Inc. (AMCEE)
Georgia Institute of Technology
Atlanta, Georgia 30332

A Survey of Continuing Education for Nonacademic Scientists and Engineers Provided by Industry and Government (Completed)

Dr. Girard W. Levy **E**
Battelle Memorial Institute
Columbus, Ohio 43201

Needs Assessment of Continuing Education Delivery Systems for Scientists and Engineers Employed in Small, Geographically-Dispersed Plants

Dr. Lawrence G. Welling **F**
Battelle Memorial Institute
Columbus, Ohio 42301

Regional Workshop for Continuing Education of Working-Level Scientists and Their Supervisors

Dr. Roger D. Bauer A
School of Natural Sciences
California State University
Long Beach, California 90840

Workshop on Continuing Education for Industry, Professional Societies and Universities (Completed)

Dr. Sonja S. Marchand B
California State University
Northridge, California 91330

An Evaluation Model for State of the Art Programs for Professional Engineers

Dr. Martha Maxwell C
University of California
Berkeley, California 94720

Evaluation of Short Course Method of Instruction for Practicing Professionals in Engineering

Dr. Alfred C. Ingersoll D
University of California
Los Angeles, California 90024

An Investigation Into Learning Patterns of Adults in Alternative Modes of Continuing Engineering Education as Compared With Those of Undergraduates and Graduates (Completed)

Dr. Bernard N. Samers E
Cooper and Company
Stamford, Connecticut 06905

CEXY: A Tool for Assessing Regional CE Needs in XY Coordinates

Dr. Robert Ehrlich F
George Mason University
Fairfax, Virginia 22030

Pilot Study of Continuing Environmental Health Education for Scientists and Engineers
Dr. Dade W. Moeller A
Harvard University
School of Public Health
Boston, Massachusetts 02115

New Directors in Continuing Education: Comparative Perspectives of Decision-Making and R & D Personnel
Dr. A. George Schillinger B
Industrial Research Institute
Research Corporation
St. Louis, Missouri 63105

Measurement for Learning Outcomes in Continuing Education for Scientists and Engineers
Dr. David K. Blythe C
College of Engineering
University of Kentucky
Lexington, Kentucky 40506

A Model Continuing Education Needs Assessment/Response System in Science and Engineering
Dr. John W. Zemp D
Medical University of South Carolina
Charleston, South Carolina 29403

Continuing Education Needs of Engineers/Scientists in the Three-State Ozark Region
Dr. John M. Amos E
University of Missouri/Rolla
Center for Applied Engineering Management
Rolla, Missouri 65401

U.S. Electronics Industry Continuing Education Effectivity Study
Dr. Robert M. Janowiak F
National Engineering Consortium, Inc.
Oak Brook, Illinois 60521

Continuing Education for Scientists and Engineers: Delivery Systems in North Carolina
Dr. Daniel E. Harrell A
School of Engineering
North Carolina State University
Raleigh, North Carolina 27650

Behavior Anchored Scales - A Method of Identifying Continuing Education Needs of Engineers
Dr. James L. Farr B
Pennsylvania State University
University Park, Pennsylvania 16802

Relationships Among Individual Motivation, Work Environment and Updating in Engineering
Dr. James L. Farr C
Pennsylvania State University
University Park, Pennsylvania 16802

Factors Determining the Effectiveness of Continuing Education: Longitudinal Analyses in Engineering Organizations
Dr. Harold G. Kaufman D
Polytechnic Institute of New York
Brooklyn, New York 11201

Impact of Management Practices and Organizational Climate on Motivation of Scientific Engineering Personnel
Dr. William A. Snow E
Rockwell International
2230 East Imperial Highway
El Segundo, California 90245

Study of CLE Methodologies Potentially Transferable to CESE
Dr. Robert J. Smith F
Department of Engineering &
Applied Science
University of Wisconsin-Ext.
Madison, Wisconsin 53706

Assessment of Scientists'/Engineers' Continuing Education Needs in Small, Geographically-Dispersed Industries
Dr. W. Sam Adams A
University of Wisconsin
Oshkosh, Wisconsin 54901

ASSESSMENT OF SCIENCE EDUCATION IN THE TWO-YEAR COLLEGE

Conference on the Assessment of Science Education in the Two-Year College (Completed)
Dr. Richard E. Wilson B
American Association of Community
& Junior Colleges
Washington, D.C. 20036

Local Assessment of Science Education in the Two-Year College (Completed)
Dr. Janan M. Hayes C
American River College
Los Rios Community College District
4700 College Oak Drive
Sacramento, California 95841

Local Assessment of Science Education in the Two-Year College (Completed)
Dr. Bobbie Jean Nicholson D
Brevard College
Brevard, North Carolina 28712

Analysis of Student Skills, Needs and Goals (Completed)
Dean Frank E. Truesdale E
Bunker Hill Community College
Rutherford Avenue
Charlestown, Massachusetts 02129

Local Assessment of Science Education in the Two-Year College (Completed)
Prof. Charles Allbee F
Burlington County College
Pemberton-Brown Mills Road
Pemberton, New Jersey 08068

Local Assessment of Science Education in the Two-Year College (Completed)
Prof. Robert L. Sawyer A
Catonsville, Community College
800 South Rolling Road
Catonsville, Maryland 21228

Local Assessment of Science Education in the Two-Year College (Completed)
Prof. Donald Fama B
Cayuga County Community College
Auburn, New York 13021

Assessment of a Change to a Modularized Approach to Science Instruction (Completed)
Dr. Faustine Perham C
Central YMCA Community College
211 W. Wacker Drive
Chicago, Illinois 60606

Appraisal of Current Science Education at a Developing Community College (Completed)
Dr. Richard A. Dodge D
Cerro Coso Community College
College Heights Boulevard
Ridgecrest, California 93555

Science Education in the Non-Campus College: A Needs Assessment (Completed)
Dr. Jack McGill E
Coastline Community College
Coast Community College District
10231 Slater Avenue
Fountain Valley, California 92708

Assessment of Science Education at Cowley County Community College (Completed)
Prof. Mike Watters F
Cowley County Community College
125 South Second Street
Arkansas City, Kansas 67005

Local Assessment of Science Education in the Two-Year College (Completed)
Prof. Billie Ann Rice A
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Central Campus, Math Dept.
555 North Indian Creek Drive
Clarkston, Georgia 30021

Local Assessment of Science Education in the Two-Year College (Completed)
Dr. Edward A. Ochoa B
El Paso County Community College
6601 Dyer Street
El Paso, Texas 79904

Assessing the Biological Science Needs of Community College Freshmen (Completed)
Prof. Donald S. Emmeluth C
Fulton-Montgomery Community College
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Johnstown, New York 12095

Local Assessment of Science Education in the Two-Year College (Completed)
Dr. Martha T. Hatcher D
Gainesville Junior College
Gainesville, Georgia 30501

Local Assessment of Science Education in the Two-Year College (Completed)
Dr. William F. Hibschman E
401 Thomas Run Road
Harford Community College
Bel Air, Maryland 21014

Science for the Non-Science Student at Illinois Central College: An Assessment of Science Needs for Community College Students (Completed)
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Illinois Central College
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East Peoria, Illinois 61635

Local Assessment of Science Education in the Two-Year College (Completed)

Ms. Lena Dexter A
James H. Faulkner State
Junior College
Bay Minette, Alabama 36507

Local Assessment of Science Education in the Two-Year College (Completed)

Mr. G. Elliott Tyler B
John C. Calhoun State Community
College
Decatur, Alabama 35602

Local Assessment of Science Education in the Two-Year College (Completed)

Mr. Robert Ernst C
Kirkwood Community College
P.O. Box 2068
Cedar Rapids, Iowa 52406

Local Assessment of Science Education in the Two-Year College (Completed)

Dr. William J. Lembeck D
Louisiana State University
Eunice, Louisiana 70535

An Investigation of the Applicability of Computer-Assisted Instruction in the Social Science Division of Monterey Peninsula College

Mr. Bela Banathy E
Monterey Peninsula College
Monterey, California 93490

Local Assessment of Science Education in the Two-Year College (Completed)

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Mountain View College
4849 W. Illinois
Dallas, Texas 75211

Local Assessment of Science Education in the Two-Year College
(Completed)
Prof. Everett C. House A
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Students, Curricula and Laboratories - A Needs Assessment
(Completed)
Mr. Malcolm Nason B
North Shore Community College
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Local Assessment of Science Education in the Two-Year College
(Completed)
Dr. George G. West C
Northern Virginia Community College
Alexandria, Virginia 22311

Local Assessment of Science Education in the Two-Year College
(Completed)
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Chemistry and Biology Laboratory Facilities and Curricula
(Completed)
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670 West Boylston Street
Worcester, Massachusetts 01606

The Next Step: A Computer Facilities Master Plan for Saddleback
(Completed)
Prof. Dave Campbell F
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28000 Marguerite Parkway
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Assessment of Mathematics Program at S. D. Bishop State Junior College (Completed)
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Assessment of Placement Needs of Students (Completed)
Ms. Donna E. Scott B
Southeastern Community College
Whiteville, North Carolina 28472

Suomi College Science Education Assessment Project (Completed)
Mr. Donald Wanhala C
Suomi College
Hancock, Michigan 49930

Triton's Comprehensive Self-Assessment of Science Education (Completed)
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River Grove, Illinois 60171

Local Assessment of Science Education in the Two-Year College (Completed)
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Local Assessment of Science Education in the Two-Year College (Completed)
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Study of Science Education in Two-Year Colleges
Dr. Lance Hodes A
Westat, Inc.
Rockville, Maryland 20852

Evaluation and Needs Assessment for Mathematics Education (Completed)
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Western Wyoming Community College
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Rock Springs, Wyoming 82901

Local Assessment of Science Education in the Two-Year College (Completed)
Dr. John S. DiYorio C
Wytheville Community College
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Wytheville, Virginia 24382

RESEARCH IN SCIENCE EDUCATION

Computer-Assisted Science Exhibits
Dr. W. M. Laetsch D
Lawrence Hall of Science
University of California
Berkeley, California 94720

A Research Evaluation of Scientific Reasoning Ability in Naturalistic and Laboratory Settings
Dr. W. M. Laetsch E
University of California
Berkeley, California 94720

Increasing the Meaningfulness of Technical Information for Novices
Dr. Richard E. Mayer F
University of California
Santa Barbara, California 93106

A Study of Science Instructional Programs in Two-Year Colleges
Dr. Arthur M. Cohen A
Center for the Study of
Community Colleges
Los Angeles, California 90024

Project Synthesis: An Interpretive Consolidation of Research Identifying Needs in Precollege Science Education
Dr. Norris Harms B
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Strategies for Learning Emphasizing the Nature and Role of Concepts
Dr. Joseph D. Novak C
Cornell University
Dept. of Education and
Biological Science
Ithaca, New York 14853

Research Into Important Factors Influencing Female Selection of First Optional Mathematics Courses
Dr. Alma E. Lantz D
Denver Research Institute
University of Denver
Denver, Colorado 80208

The Use of Heuristics in Problem Solving: An Expository Study (Completed)
Dr. Mary Grace Kantowski E
University of Florida
Gainesville, Florida 32602

An Analysis of Research on Mathematical Abilities (Completed)
Dr. Jeremy Kilpatrick F
University of Georgia
Athens, Georgia 32609

Learning and Teaching Whole Numbers: An Interdisciplinary Study of an Experimental Model

Dr. Leslie P. Steffe A
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University of Georgia
Athens, Georgia 30602

A Meta-Analysis of Productive Factors in Science Learning in Grades 6 Through 12

Dr. Herbert J. Walberg B
College of Education
University of Illinois/Chicago Circle
Chicago, Illinois 60680

Research on Thought Processes Used in 7th to 10th Grade Mathematics

Dr. Robert B. Davis C
University of Illinois
Urbana, Illinois 61801

Measurement and Analysis of Patterns of Logical Thinking

Dr. Frederick P. DeLuca D
Iowa State University
Ames, Iowa 50011

A Research Study of Computer-Based Tutoring of Mathematical and Scientific Knowledge

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Massachusetts Institute of Technology
Cambridge, Massachusetts 02139

Assessment and Documentation of a Children's Computer Laboratory (Completed)

Dr. Seymour A. Papert F
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Identifying Different Levels of Understanding Attained by Physics Students (Completed)

Dr. Frederick W. [illegible]yron, Jr. A
University of Massachusetts
Amherst, Massachusetts 01003

Statistical Analysis of Research Results in College Science Teaching (Completed)

Dr. James A. Kulik B
University of Michigan
Ann Arbor, Michigan 48109

A Study of Computer Use and Literacy in Science Education

Dr. Daniel Klassen C
Minnesota Educational
Computing Consortium
St. Paul, Minnesota 55113

A Study of Priorities In School Mathematics (PRISM)

Dr. Alan Osborne D
National Council of
Teachers of Mathematics
Ohio State University
Columbus, Ohio 43210

Psychological Problem Space and Motivation in Adolescent Learning: A Study of Information Processing

Dr. Donald W. McCurdy E
Department of Secondary Education
University of Nebraska
Lincoln, Nebraska 68588

Research Studies of the Scientific Literacy of the Attentive Public (Completed)

Dr. Jon D. Miller F
Northern Illinois University
DeKalb, Illinois 60115

A Review of Research on Solving Routine Problems in Pre-College Mathematics (Completed)
Dr. Larry Sowder A
Northern Illinois University
DeKalb, Illinois 60115

The Relationship Between Student Attitudes Toward the Science Curriculum and Selected Variables
Dr. Thomas M. Haladyna B
Education/Development
Research Program
Oregon State System of
Higher Education
Monmouth, Oregon 97361

Determinants of Student Entry and Performance in the Sciences (Completed)
Dr. George H. Dunteman C
Research Triangle Institute
Research Triangle Park, North Carolina 27709

An Inquiry Into the Graduate Training Needs of Two-Year College Teachers of Mathematics
Dr. Robert McKelvey D
Rocky Mountain Mathematics
Consortium
c/o Arizona State University
Temple, Arizona 85281

The Role of Cognitive Style in the Learning of Mathematics: A Research Study (Completed)
Dr. Douglas B. McLeod E
San Diego State University
San Diego, California 92182

An Investigation on the Effect of Field Trips on Science Learning (Completed)
Dr. John H. Falk F
Smithsonian Institution
Chesapeake Bay Center for
Environmental Studies
Edgewater, Maryland 21037

Social Studies/Social Science Education: Priorities, Practices and Needs
Dr. Irving Morrissett A
Social Science Education
Consortium, Inc.
855 Broadway
Boulder, Colorado 80302

Sex Differences in Perceptual, Motor and Cognitive Skills as Related to Mathematics and Science
Dr. Karl H. Pribram B
Department of Psychiatry
Stanford University
Stanford, California 94305

Investigation of Conceptual Development in the Study of Motion
Dr. Lillian C. McDermott C
Department of Physics
University of Washington
Seattle, Washington 98195

Research on Relationship of Spatial Visualization and Confidence to Male/Female Mathematics Achievement in Grades 6 to 8
Dr. Elizabeth Fennema D
Dept. of Curriculum & Instruction
University of Wisconsin
Madison, Wisconsin 53706

Systematic Investigation of the Cognitive Effects of Games on Mathematics Learning
Dr. John G. Harvey E
University of Wisconsin
Madison, Wisconsin 53706

NATIONAL INSTITUTE OF EDUCATION-NATIONAL SCIENCE FOUNDATION COLLABORATIVE PROGRAM ON RESEARCH ON COGNITIVE PROCESSES AND THE STRUCTURE OF KNOWLEDGE IN SCIENCE AND MATHEMATICS

(Funding and Administration for the following projects provided jointly by the National Institute of Education and by NSF under the above-named research program.)

Underlying Heuristic and Formal Structures of Probabilistic Thought
Dr. Michael D. Butler **A**
School of Social Sciences
University of California
Irvine, California 92717

Cognitive Processes and the Structure of Knowledge in Physics and Algebra
Dr. Herbert A. Simon **B**
Carnegie-Mellon University
Pittsburgh, Pennsylvania 15213

Analysis of the Development of Propositional Reasoning
Dr. Rachel Joffe Falmagne **C**
Clark University
950 Main Street
Worcester, Massachusetts 01610

The Development of Applied Scientific Thinking in Children and Adolescents
Dr. Robert Louis Selman **D**
Harvard College
Cambridge, Massachusetts 02138

The Representation and Learning of Knowledge Structures in Experimental Psychology
Dr. Leon Manelis **E**
Illinois State University
Normal, Illinois 61761

The Role of Preconceptions & Representational Transformations in Understanding Science and Mathematics
Dr. Frederick W. Byron, Jr. **F**
University of Massachusetts
Amherst, Massachusetts 01003

The Logical, Mathematical, and Psychological Structure of Counting and of Early Number Concepts
Dr. Karen C. Fuson A
Northwestern University
Evanston, Illinois 60201

Invention and Understanding in the Acquisition of Computation
Dr. Lauren B. Resnick B
Learning Research & Development
Center
University of Pittsburgh
3939 O'Hara Street
Philadelphia, Pennsylvania 15260

Research on Process Models of Basic Arithmetic Skills
Dr. Patrick Suppes C
Stanford University
Institute for Mathematical Studies
in the Social Sciences
Stanford, California 94305

Psychology of Equation Solving: An Information Processing Study
Dr. L. Ray Carry D
University of Texas
Austin, Texas 78712

Learning From Science and Mathematics Textbooks: Text Structure, Reading Strategies and Comprehension
Dr. James Deese E
University of Virginia
Charlottesville, Virginia 22901

SECTION III

Key Word/Phrase Index

This index is an alphabetical listing of salient words and phrases derived from all project summaries of awards made in the Development in Science Education (DISE) Program and the Research in Science Education (RISE) Program in Fiscal Year 1979, in Fiscal Year 1978, and in earlier years. Page references are keyed to the roster of awards for FY 1979 beginning on page 1, so when the reader selects a particular area of interest, such as *Expert-Novice Studies* or *Computer-Assisted Instruction*, page numbers are supplied for locating projects concerned with that subject.

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